VOL. XXIX. — No. 7. JULY 1952.

Monthly Bulletin of the International Railway Congress Association

(English Edition)

British Railways main line locomotives

'The Times' photograph by courtesy of British Railways

Two 1,750 h.p. 1Co-Col type diesel-electric locomotives for express passenger service have recently been built by British Railways, Southern Region, at their Ashford Works and are employed on the haulage of express passenger trains between London (Waterloo) and Exeter; also between London, Bournemouth and Weymouth. The diesel-electric equipment for both locomotives was built by 'English Electric'. The first locomotive, No. 10201, was exhibited at the Festival of Britain 1951 Exhibition. The second, No. 10202, entered regular service between London and Exeter on the 15th October, 1951 and had covered 64,653 miles between that date and 2nd February, 1952, making two return trips daily with an aggregate train mileage of 687 per day for the bulk of this period.

'ENGLISH ELECTRIC'

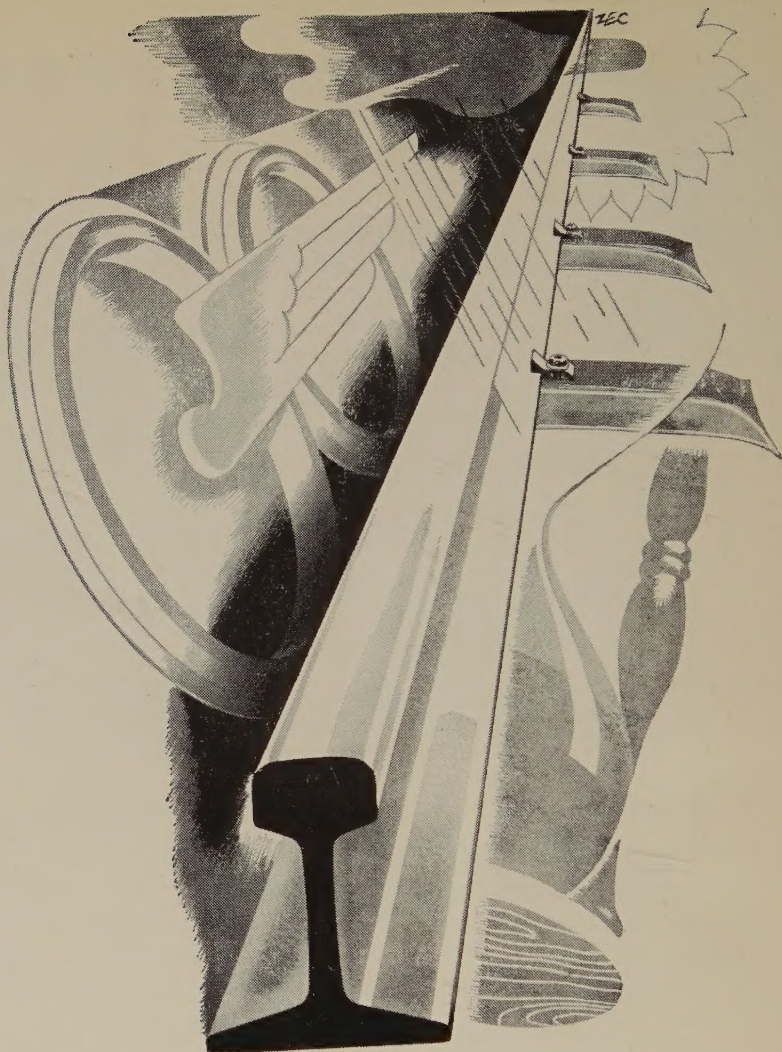
diesel-electric locomotives

The ENGLISH ELECTRIC Company Limited, Queens House, Kingsway, London, W.C.2

Traction Department, London

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

TNDE.12


ZEC

Alphabetical Index of Advertisers

MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU-SITE, BRUSSELS

Yearly subscription for 1952 :	**Belgium**	**700 Belgian Francs**
	Universal Postal Union. . .	**800 Belgian Francs**

Price of this single copy : 80 Belgian Francs (not including postage).

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 19, rue du Beau-Site, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

CONTENTS OF THE NUMBER FOR JULY 1952.

CONTENTS *(continued)*.	Page.

LIBRARY

OF THE

Permanent Commission of the International Railway Congress Association

READING ROOM : 19, rue du Beau-Site, Brussels.

Works in connection with railway matters, which are presented to the Permanent Commission are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association. Books, etc., may not be taken away except by special permission of the Executive Committee.

An edition in French is also published.

Vol. XXIX. — No. 7. July 1952.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[625 .113]

Transition curves,

by J. CHAPPELLET,

(Ingénieur honoraire de la Société Nationale des Chemins de fer français,
Service central de la Voie de la Région Nord).

Mr. HALLADE, Graduate of the « Ecole Polytechnique », Ingénieur principal aux Chemins de fer de l'Est, published in the *Revue générale des Chemins de fer*, April, 1908, his first study of « Transition curves ».

The equation at which he arrived :

$$Y = \frac{1}{2R}\left[\frac{x^2}{2} - \frac{l^2}{\pi^2}\left(1 - \cos\frac{\pi}{l}\right)x\right],$$

l = length of curve, R = radius of the arc, necessitated the use of tables; we therefore pursued the subject and proposed, in 1930, in papers to the officers of the Nord Railway, the parabole $Y = \frac{x^4}{C}$.

Mr. SCHRAMM, Dr.-Eng., Technical Adviser to the Reichsbahn, unaware of our investigations, arrived at the same equation, $Y = \frac{x^4}{C}$, and published his study in the *Organ* of December, 1934.

More recently, the *Revue générale des Chemins de fer* (January, 1949) gave a résumé of a very detailed mathematical theory of transition curves by Mr. CAQUOT, membre de l'Académie des Sciences, which required the use of tables.

The fourth degree parabola, however, the formula for which is very simple, is easily traced with a high degree of accuracy by the method used for correcting curves by measuring the versines; in addition, it meets theoretical considerations which take sufficiently into account the oscillation of vehicles, the elastic deformation of the track and the uncertain value of the numerical coefficients which apply to the suspension components of the vehicles.

For all these reasons, we believe that the use of the fourth degree parabola as a transition curve offers considerable advantages in certain special cases of difficult track lay-out, although the realization of the corresponding superelevation may be very exacting and its maintenance at the theoretical value a very heavy task.

Purpose and definition of a transition curve.

Diagram of superelevation of a transition curve.

When the leading axle of a vehicle enters a true parabolic curve, it is instantly subjected to a sharp transverse rotation when entering at A (fig. 1) the superelevation slope A B; the left hand wheel

rises and compresses its spring, the right hand wheel drops and extends its spring, both pivoting around the axis O of the track (fig. 2).

Furthermore, this axle lifts at a speed equal to $V_1 = iV$. If the vehicle has a length a, it takes a time $t = \frac{a}{V}$ fully to enter the slope and the vertical acceleration of the axle is equal to

$$\gamma = \frac{V_1}{t} = \frac{iV}{\frac{a}{V}} = \frac{iV^2}{a}.$$

Because of the inertia of the body of the vehicle, the springs of the leading axle are compressed. Finally, the body of the vehicle is subjected to oscillations which are damped between A and B, when

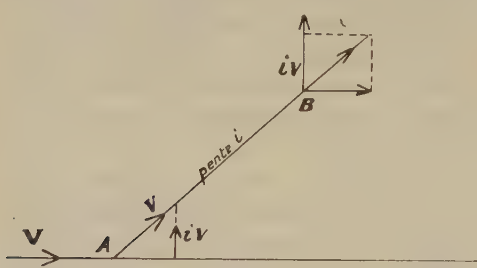


Fig. 1.

the slope is long enough. Between A and B the axle is subject to a transverse rotary movement in the direction of the versine (fig. 2) up to its arrival at B, where the superelevation reaches its full amount and becomes constant. Because of its inertia, however, the body continues

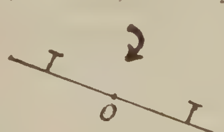


Fig. 2.

to turn, releasing the left hand spring and loading the right hand one, setting up a series of oscillations. In addition, at B, by reason of the inertia, the sprung body is lifted at the speed iV, with an acceleration $\frac{iV^2}{a}$ (the same calculation as at A) and the springs are released.

The transition curve is intended to suppress all these oscillations.

The problem which arises is to provide a suitable diagram of superelevation $S = \frac{C}{R} = C \cdot \frac{1}{R}$, from which it is easy to deduce the diagram of curvature $\frac{1}{R}$ and that of the versines :

$$f = \frac{d^2}{2R} = \frac{d^2}{2} \cdot \frac{1}{R}$$

d being the equidistance between the versines. It will then be seen that it is necessary to break up the angles at A and at B and that the appropriate superelevation diagram must be made up of a succession of superelevation slopes, the values of which must vary in a continuous and gradual degree.

This condition is fulfilled if we adopt the parabol $Y = \alpha X^2$ as the superelevation diagram. At each point of the abscissa curve X, the superelevation slope is equal to $\frac{dy}{dx} = 2\alpha X$, this slope is proportional to the abscissa X (the development of the curve is projected into the abscissae) and its unit increase is equal to :

$$\frac{\frac{dy_1}{dx} - \frac{dy_2}{dx}}{dx} = \frac{d^2Y}{dx^2} = 2\alpha.$$

Giving α a suitable value, we get at each point an increase in gradient as small as may be desired.

When the vehicle of length a is wholly on the curve and has reached a slope equal to $2\alpha a$, the speed of rise of the leading axle is equal to $2\alpha a V$ and for this it has taken a time equal to $\frac{a}{V}$.

The vertical acceleration of the axle is therefore equal to :

$$\gamma = \frac{V}{t} = \frac{2\alpha a V}{\frac{a}{V}} = 2\alpha V^2$$

constant, moreover, in the whole of the curve.

of the vehicle, which is about 15 m (49′ 2½″).

In addition, the speed of rotation of the rolling is no longer constant, as in a parabolic curve. It is cancelled out at the start and finish of the curve. The dynamic force is nil and the springs do not come into play.

It is worth recalling, on the subject of oscillations of vehicles, the notable works of Mr. MARIÉ, Ingénieur aux Chemins de fer du P. L. M., works from which originated the study of Mr. HALLADE on transition curves, and which were published under the title : *Traité de stabilité du Matériel des Chemins de fer.* — Publishers : Béranger, Paris, 1924.

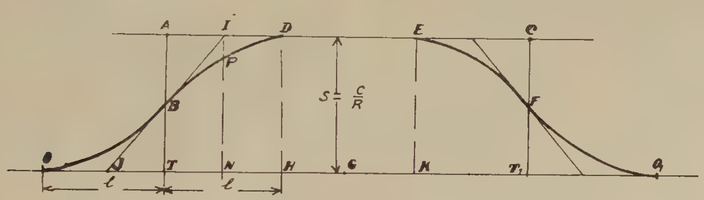


Fig. 3.

We shall see that $\alpha = \frac{I}{2l}$, I the maximum slope of the curve, l half the length of the curve, from which $\gamma = \frac{IV^2}{l}$. If we compare the vertical acceleration already calculated, $\frac{iV^2}{a}$, when entering a parabolic curve, we see that even making $I = 2i$, the acceleration $\frac{IV^2}{l}$ is much lower than the acceleration $\frac{iV^2}{a}$, since l is half the length of the curve and a is the wheelbase

The superelevation diagram of a transition curve is therefore determined by two equal parabolas of the second degree, O B and B D, tangential at B, of the abscissa $x = l$, arranged as in figure 3.

The parabola O B softens the lead into the curve, the parabola B D softens the run out of it. The slope of their common tangent at B is the maximum slope of the superelevation of the curve. This slope is determined by considerations of the lay-out. From O to T the superelevation is given by the formula $s = \alpha x^2$, the acceleration of lift is equal to $2\alpha V^2$

$= \frac{IV^2}{l}$, constant throughout the curve, I being the maximum slope at B.

From T to H the superelevation is given by the formula $s = \alpha x^2$ also, subject as we shall see later, to A D being taken as the axis of the abscissae and D as the start of the abscissae.

From T to H the ordinates such as A B are thus negative, the same applies to acceleration of lift and, theoretically, at B, the sharp variation in this acceleration is equal to :

$$\frac{IV^2}{l} - \left(-\frac{IV^2}{l}\right) = \frac{2\,IV^2}{l},$$

which is a negligible variation in view of the low value of $\frac{IV^2}{l}$. At the same point, theoretically, the very low rotary speed of rolling changes direction, which is of little importance. Moreover, in practice, these changes of direction are not instantaneous, they arise over about 10 m (11 yards).

Superelevation diagram of a circular arc of radius R and its transition curves.

Let us connect an arc of a circle of radius R with straight alignments which are tangential to it, by two transition curves.

The theoretical superelevation diagram of the circular arc is the rectangle T A C T_1 (fig. 3), with a length T T_1 and a height equal to $S = \frac{C}{R}$. T and T_1 are the two tangent points of the circular arc and the straight sections. Across the tangent points are placed the superelevation diagrams O B D and E F O_1 of the transition curves at the beginning and end of the circular arc. Finally, the superelevation diagram of a circular arc connected to straight tangential lines by transition curves is the area O B D E F O_1 (fig. 3), the parabolas O B, B D, E F and F O_1 being placed, as we shall see later, symmetrically in relation to the centre G of the circular arc.

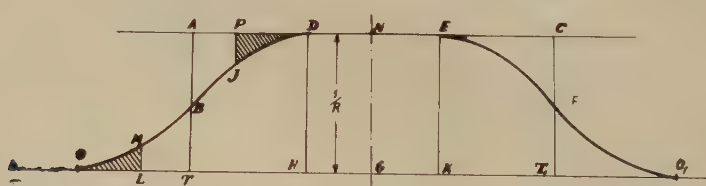


Fig. 4.

Diagram of the curves and versines of a circular arc, radius R, and of its transition curves.

The curvature diagram $\frac{1}{R}$ (fig. 4) is easily deduced from the superelevation diagram in figure 3, by dividing the ordinates of the latter by the coeffficient C. In effect $S = \frac{C}{R}$, from which $\frac{1}{R} = \frac{S}{C}$. The ordinates of the curves O B and O_1 F of the diagram of curvature, figure 4, are equal to the ordinates of the parabolas

O B and O_1 F of the superelevation diagram, figure 3, divided by C, that is to say, equal to $y = \frac{\alpha x^2}{C}$. The curves O B and O_1 F of the diagram of curvature of figure 4 are thus also parabolas of the second degree, as are the curves B D and E F. The diagram of the versines (not drawn) is also easily deduced from the superelevation diagram, since for a chord of $2d$, we have :

$$f = \frac{d^2}{2R} = \frac{d^2}{2} \times \frac{1}{R} = \frac{d^2}{2} \times \frac{S}{C} = \frac{S}{\frac{2C}{d^2}}$$

It is sufficient to divide all the ordinates of the superelevation diagram by $\frac{2C}{d^2}$. The curves O′ B′ and O_1 F′ of the diagram of versines (not drawn) corresponding to the parabolas O B and O_1F of figure 3 are also parabolas, their ordinates being equal to $y = \frac{x^2}{\frac{2C}{d^2}}$; consequently, the curves B′D′ and E′F′ of the diagram of versines corresponding to the parabolas B D and E F of figure 3 are also parabolas of the second degree.

Position of transition curves in relation to the circular arc.

If we consider, on the one hand, the lay-out of the circular arc T T_1, of radius R, and on the other hand, the lay-out of the same arc and its two transition curves, these two lay-outs abut on to the same two straight sections; their curvature diagrams have equal areas and the centres of gravity of these diagrams are placed on the same ordinate; they have the same abscissa.

It is practically the same with the diagram of the versines of these two outlines, since each curve $\frac{1}{R_x} = \frac{2f_x}{d^2}$ is proportional to the versine, without any appreciable error.

If we consider the diagram of curvature of figure 4, the centre of gravity of the diagram of curvature of the arc is found at the centre of the rectangle T A C T_1, or on the vertical G N. The centre of gravity of the diagram of curvature of the arc and its two transition curves, i. e. the area O B D E F O_1, is found on the same vertical G N. On the other hand, the two areas T A C T_1 and O B D E F O_1 being equal, it follows that the areas O B T, B A D, E C F and T_1 F O_1 are equal, the parabolas of the second degree O B, B D, E F and F O_1 are also equal and we have : O T = T H = K T_1 = T_1 O_1.

If $2l$ is the length of the transition curves, the points O, H, O_1 and K will be obtained by measuring on the straight sections from both sides of the tangent points T and T_1, lengths equal to l.

The problem is fully resolved.

The superelevation diagram A B D E F O_1 (fig. 3) having been calculated with reference to the requirements of the lay-out, we deduce from it the diagram of the versines corresponding to the diagram of curvature in figure 4. This diagram of versines is then superimposed on the diagram of the versines for the curve to which we wish to add the two transition curves. The lay-out of this curve and the two transition curves is

obtained by calculating the displacements to be given to the original curve in function of the differences in versines of the two diagrams, following the normal procedure.

Calculation of superelevation diagram.

Let us consider the superelevation diagram in figure 3. We have :

$$B\,T = y = \alpha x^2 = \alpha l^2 = \frac{S}{2}.$$

The slope I, at B, of the parabola O B, is equal to :

$$\frac{dy}{dx} = 2\alpha x = 2\alpha l = I.$$

This is the maximum superelevation of the transition curve for $x = l$. We therefore have :

$$\alpha = \frac{I}{2l},$$

then :

$$y = \frac{I}{2l} x^2$$

$$\frac{B\,T}{J\,T} = I,\ B\,T = \frac{I}{2l} l^2 = \frac{Il}{2},$$

then :

$$\frac{\frac{Il}{2}}{J\,T} = \frac{Il}{2\,J\,T} = I,$$

or

$$\frac{l}{2\,J\,T} = 1 \text{ and } l = 2\,J\,T = OJ + J\,T$$

we therefore get :

$$O\,J = JT = \frac{l}{2}$$

and then :

$$I = \frac{\frac{C}{2\,R}}{\frac{l}{2}} = \frac{C}{Rl},\quad \text{since } B\,T = \frac{S}{2} = \frac{C}{2\,R}.$$

Application.

Calculation of the abscissa of the centre of gravity G of the diagram of the versines of the curve to be modified.

We shall first of all determine the abscissa g of the centre of gravity G of the diagram of the versines of the curve to be modified.

The abscissa g of this centre of gravity, measured from the zero picket, is obviously equal to the quotient of the sum of the moments, in relation to the zero picket, of the versines, considered as forces, by the sum of these versines.

Let us consider a curve of which the mean radius in the circular part is equal to 500 m (547 yards) (it does not seem worth giving a diagram of the versines) the sum of the moments of the versines in relation to the zero picket is equal to S = 33 393 and the sum of the versines is equal to $s = 2\,245$.

The abscissa g (fig. 5) is equal to :

$$\frac{33\,393}{2\,245} = 14.8745,$$

the unit being the equidistance between the pickets, since the lever arms of the versines are evaluated in equidistances. For an equidistance of 10 m (10.93 yards), we obviously have $g = 14.8745 \times 10$ m $= 148.745$ m. We know that this abscissa is also that of the centre of gravity of the diagram of curvature corresponding to this diagram of versines.

Determination of the tangent points of the original circular arc.

Let us determine the tangent points of the original circular arc laid out with a

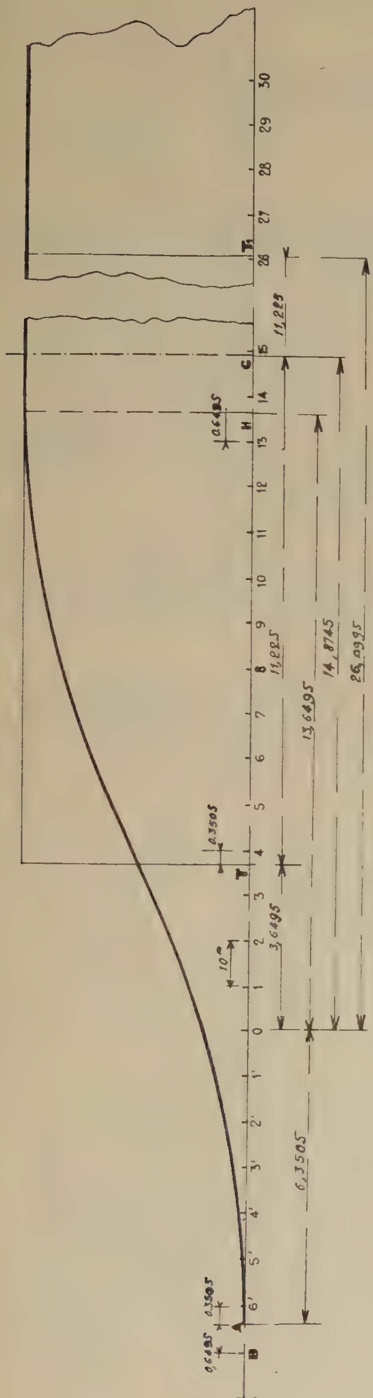


Fig. 5.

radius of equal to 500 m, of which the versine for a chord of 20 m is equal to 100 mm.

The area of the diagram of the versines of this original circle is obviously equal to 100 mm $\times$ $2d$, $2d$ being the number of equidistances corresponding to the development of the circular arc.

Furthermore, this area being equal to that of the versine diagram of the present curve, it is equal to the product of the sum of the versines by the equidistance 1, or 2 245 $\times$ 1.

From this :

$$100 \times 2d = 2\,245 \times 1$$

and

$$d = \frac{2\,245}{200} = 11.225$$

equidistances.

The centres of gravity of the versine diagram of the present curve and of the versine diagram of the original arc having the same abscissa measured from the zero picket, extending on both sides of the ordinate of the centre of gravity G, a length equal to 11.225 equidistances, we obtain the tangent points T and T_1.

Finally, the tangent points T and T_1 are respectively at 3.6495 and 26.0995 equidistances from the zero picket.

Calculation of the superelevation diagram of the transition curve.

The superelevation in the circular part is equal to :

$$S = \frac{100}{500} = 0 \text{ m } 20,$$

100 being the coefficient C of superelevation. The maximum superelevation slope permitted is equal to 2 mm/m.

We have (fig. 3) :

$$BT = \frac{0.20}{2} = 0.10,\ JT = \frac{BT}{I} = \frac{0.10}{0.002} =$$

50 m or 5 equidistances. $l = 2\ JT = 50 \times 2 = 100$ m, or 10 equidistances.

The origin of the superelevation diagram is thus 10 equidistances in front of the tangent point T, or at 10 — 3.6495 = 6.3505 equidistances from the zero picket.

The total length of the superelevation diagram being equal to $2l = 100$ m $\times\ 2 = 200 = 20$ equidistances, its extremity is found at 20 — 6.3505 = 13.6495 equidistances from the zero picket.

We have seen that :

$$\alpha = \frac{I}{2l},$$

I maximum superelevation slope, for $I = 0.002$, $l = 100$ m, we have :

$$\alpha = \frac{0.002}{2 \times 100} = 0.00001$$

and the equation of the parabola of the superelevation diagram is equal to : $y = 0.00001\ x^2$, which allows us to calculate the ordinates of the diagram from O to T. From T to H (fig. 3), the ordinates of the superelevation, such as N P, are equal, at each point of the curve, to the difference between the superelevation of the circular part and the ordinate I P. of the parabola B D.

We shall see that the ordinates of this parabola are equal to those of the parabola O B, taking A C as the axis of the abscissae and O as the start of the abscissae.

Let us calculate the superelevation.

Calculation of superelevation.

1° from A to T

Picket A	$S = 0$	0
Picket 6′	$S = 0.00001 \times \overline{3.505}^2 =$	0
Picket 5′	$S = 0.00001 \times \overline{13.505}^2 =$	2 mm
Picket 4′	$S = 0.00001 \times \overline{23.505}^2 =$	6 mm
Picket 3′	$S = 0.00001 \times \overline{33.505}^2 =$	11 mm
Picket 2′	$S = 0.00001 \times \overline{43.505}^2 =$	19 mm
Picket 1′	$S = 0.00001 \times \overline{53.505}^2 =$	29 mm
Picket 0	$S = 0.00001 \times \overline{63.505}^2 =$	40 mm
Picket 1	$S = 0.00001 \times \overline{73.505}^2 =$	54 mm
Picket 2	$S = 0.00001 \times \overline{83.505}^2 =$	70 mm
Picket 3	$S = 0.00001 \times \overline{93.505}^2 =$	87 mm
Picket T	$S = 0.00001 \times \overline{100}^2 =$	100 mm

2° from H to T

Picket H	S = 200 mm — 0	= 200 mm
Picket 13	$S = 200 - 0.00001 \times \overline{6.495}^2$	= 200 mm
Picket 12	$S = 200 - 0.00001 \times \overline{16.495}^2$	= 197 mm
Picket 11	$S = 200 - 0.00001 \times \overline{26.495}^2$	= 193 mm
Picket 10	$S = 200 - 0.00001 \times \overline{36.495}^2$	= 187 mm
Picket 9	$S = 200 - 0.00001 \times \overline{46.495}^2$	= 178 mm
Picket 8	$S = 200 - 0.00001 \times \overline{56.495}^2$	= 168 mm
Picket 7	$S = 200 - 0.00001 \times \overline{66.495}^2$	= 156 mm
Picket 6	$S = 200 - 0.00001 \times \overline{76.495}^2$	= 142 mm
Picket 5	$S = 200 - 0.00001 \times \overline{86.495}^2$	= 125 mm
Picket 4	$S = 200 - 0.00001 \times \overline{96.495}^2$	= 107 mm

We can now trace the superelevation diagram, figure 6.

Diagram of the versines.

The diagram of versines of the transition curve from the start begins at point C, located at 1.6495 from the start of the curve, i.e. at 8 equidistances, or 80 m, from the zero picket and terminates at picket 15 situated on the arc (figs. 7 and 10). The versines to each point of the transition curve, except the versines to pickets B, 6′, 13 and 14, which we shall get by calculation, are equal to :

$$f = \frac{S}{\frac{2C}{d^2}} = \frac{S}{2} \text{ for } C = 100 \text{ and } d = 10$$

It will therefore be sufficient for us in assessing the value of the versines at each picket, to halve the value of the superelevation already calculated. We can thus build up the diagram of versines as in figure 8.

The versines of the transition curve at the exit from the curve will be calculated similarly.

Rectification of the lay-out of an existing curve.

Knowing the versines of the two transition curves, as well as the versines of the circular part we can calculate the differences between the versines measured from the curve to be modified and the calculated versines already mentioned. Double the total of these differences is equal, as we know, to half the movement necessary for the pickets of the present curve to give the alignment of the two transition curves.

Equation of the transition curve.

The calculation of the versines f_B and f_6' leads us to the establishment of the equation for the transition curve, taking

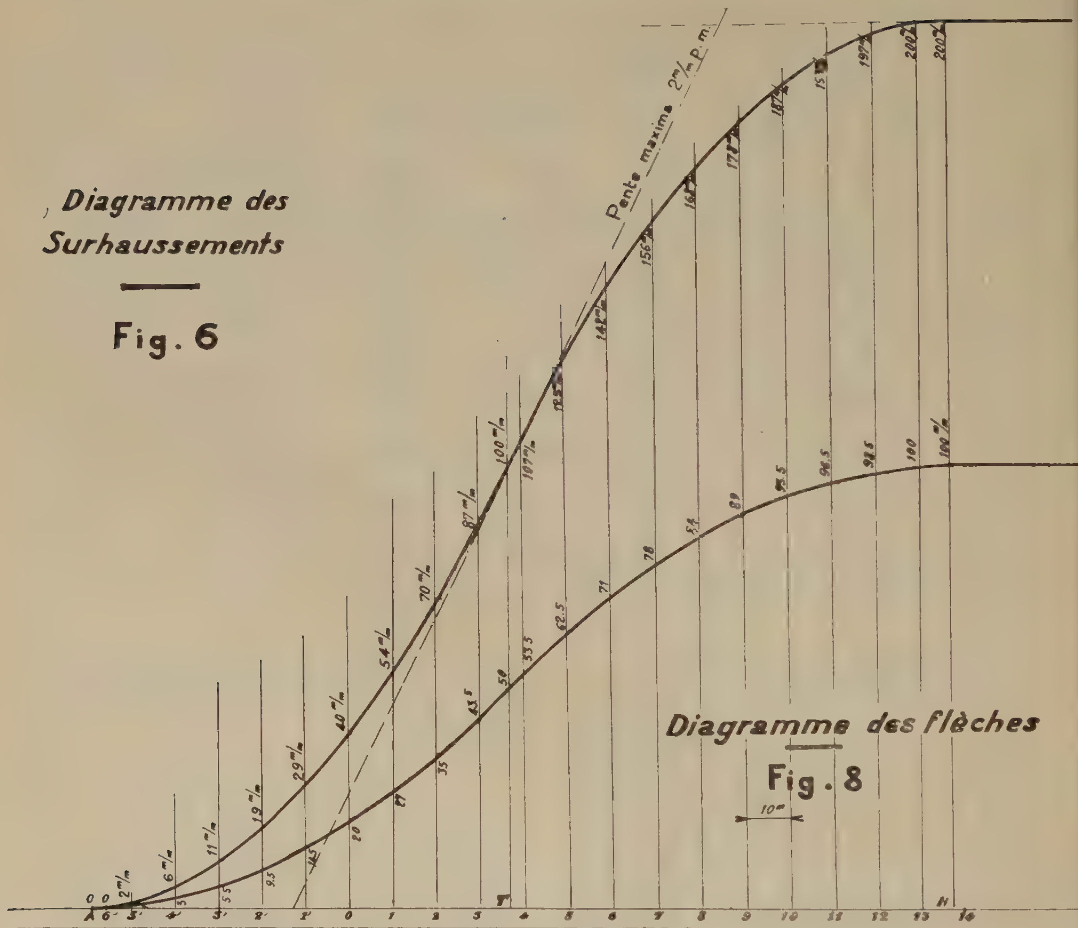


Diagramme des surhaussements = Superelevation diagram. — Pente maxima = Maximum slope.
Diagramme des flèches = Versine diagram.

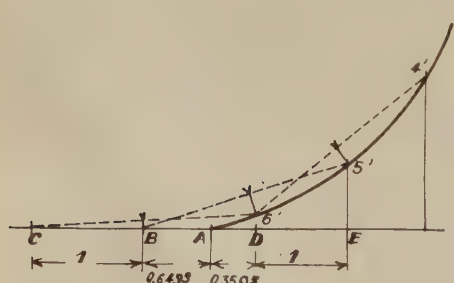


Fig. 7.

as axis of the abscissae, the straight section to which it is osculatory.

The calculation of versines f_{13} and f_{14} leads us to the establishment of the equation for this curve taking as axis of the abscissae the circle to which it is osculatory.

Equation of the transition curve, the axis of the abscissae being the osculatory straight section.

Let us consider (fig. 4) the curvature diagram of the transition curve.

The ordinate M L of the parabola O B is equal to $\frac{1}{R_x}$, x being the distance from the point L of the transition curve to the commencement O.

We have :

$$L\,M = \frac{\alpha x^2}{C} = \frac{1}{R_x},$$

C = coefficient of superelevation.

However :

$$T\,B = \frac{\alpha l^2}{C} = \frac{1}{2R},$$

by dividing, item by item, we find :

$$\frac{x^2}{l^2} = \frac{\frac{1}{R_x}}{\frac{1}{2R}},$$

from which :

$$\frac{1}{R_x} = \frac{x^2}{2Rl^2}$$

Moreover :

$$\frac{1}{R_x} = \frac{d^2y}{dx^2} = \frac{x^2}{2Rl^2}$$

which gives, successively :

$$\int \frac{x^2}{2Rl^2}\,dx = \frac{dy}{dx} = \frac{x^3}{6Rl^2}$$

and

$$\int \frac{x^3}{6Rl^2}\,dx = \int \frac{dy}{dx}\,dx = y = \frac{x^4}{24Rl^2},$$

the integration constants being nil.

This is the equation of the transition curve from the point of origin O to the tangent point T of the original arc.

Calculation of f_B (fig. 7). We have :

$$f_B = \frac{y_6'}{2}$$

$$y_6' = \frac{\overline{A\,D}^4}{24\,Rl^2} \text{ and } f_B = \frac{\overline{A\,D}^4}{48\,Rl^2}$$

A D = 0.3505 × 10 = 3.505, R = 500, l = 100 m,

$$f_B = \frac{\overline{3.505}^4}{48 \times 500 \times 100^2} \approx 0$$

Calculation of f_6'. We have :

$$f_6' = \frac{y_5'}{2} - y_6'$$

$$y_5' = \frac{\overline{A\,E}^4}{24\,Rl_2},\ AE = 1.3505 \times 10 = 13.505,$$

$$y_5' = \frac{\overline{13.505}^4}{24 \times 500 \times 100^2}$$

$$f_6' = \frac{\overline{13.505}^4}{48 \times 500 \times 100^2}$$

$$- \frac{\overline{3.505}^4}{24 \times 500 \times 100^2} \approx 0$$

Equation of the transition curve, the axis of the abscissae being the osculatory circle of radius R.

From the point of osculation H (fig. 9), the circle H T, of radius R, having a constant curvature $\frac{1}{R}$ and turning constantly by the same amount for the same development and in the same direction, the transition curve H A of which the

curvature decreases to become nil at A, can only be developed outside the circle H T. From this we get the alignment in figure 9.

Let us take this circle as axis of the abscissae and calculate the ordinate B C, that is to say the amount by which it is necessary to move the point C of the circle to B on the transition curve H A. We know that the displacement B C is equal to the moment of the area D P J (fig. 4) in relation to point P (1) so that D P may be equal to H C (fig. 9).

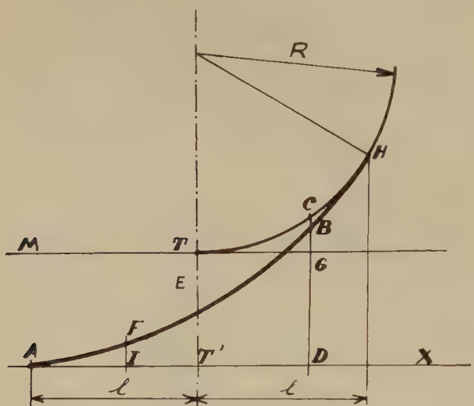


Fig. 9.

Now we take A I ≈ A F = C H. The ordinate I F, the displacement to be made at point I of the alignment A to take it to F on the transition curve A H is equal to the moment of the area O L M (fig. 4) in relation to the point L, so that A I ≈ A F = O L.

The areas D P J and O M L are equal since P D = O L and the parabolas O B and B D are equal, the moments of these areas defined above are also equal, since B C = I F and the ordinates of the second part E H of the curve A H, carried to the osculatory circle T H, taken as axis of the abscissae, the point of origin being H, are equal to the ordinates of the first part A E of the transition curve A H carried to the osculatory straight line A X, i.e. equal to :

$$y = \frac{x^4}{24\ Rl^2}$$

This property is not peculiar to parabolas of the fourth degree, we have already demonstrated (1) that it exists also for parabolas of the third degree.

Calculation of f_{14}.

The versine f_{14} of the curve is equal to the versine of the circular arc decreased by A B (fig. 10).

$$f_{14} = 100 - AB = 100 - \frac{y_{13}}{2} = 100$$

$$- \frac{\overline{6{,}495}^4}{48 \times 500 \times 100^2} = 100 \text{ mm}$$

$$AB = \frac{y_{13}}{2},\ y_{13} = \frac{\overline{13.H}^4}{24\ Rl^2},\ \frac{y_{13}}{2} = \frac{\overline{13.H}^4}{48\ Rl^2}$$

$$f_{14} = 100 \text{ mm} - \frac{\overline{13.H}^4}{48\ Rl^2},$$

$$\overline{13.H} = 0.6495 \times 10 = 6.495,\ R = 500$$

$$l = 100,$$

and

$$f_{14} = 100 \text{ mm} - \frac{\overline{6.495}^4}{48 \times 500 \times 100^2}$$

$$= 100 \text{ mm.}$$

(1) *International Railway Congress Bulletin*, September, 1930, « Railway Curves. — Parabolic curves », J. CHAPPELLET. — Publishers : Eyrolles, Paris.

Calculation of f_{13}.

We have :

$$f_{13} = 100 \text{ mm} - \frac{y_{12}}{2} + y_{13}$$

$$y_{12} = \frac{\overline{H.12}^4}{24 \text{ R}l^2}$$

$$\overline{H.12} = (1 + 0.6495)\ 10 = 16.495,$$

$$y_{12} = \frac{\overline{16.495}^4}{24 \times 500 \times 100^2}$$

$$y_{13} = \frac{\overline{6.495}^4}{24 \times 500 \times 100^2}, f_{13} = 100 \text{ mm}$$

$$- \frac{\overline{16.495}^4}{48 \times 500 \times 100^2}$$

$$+ \frac{\overline{6.495}^4}{24 \times 500 \times 100^2} = 100 \text{ mm}$$

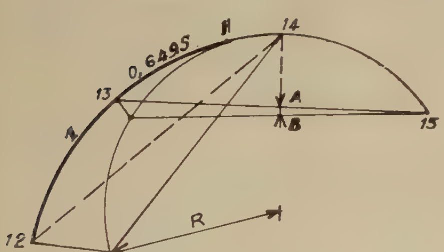


Fig. 10.

Lay-out of transition curve between A and H, the axis of the abscissae being the osculatory straight line Ax, A being the point of origin of the abscissae.

For the portion A E of the curve, it will be sufficient to calculate the ordinates such as I F by the formula :

$$y = \frac{x^4}{24 \text{ R}l^2}$$

As regards the portion E H we may calculate the ordinates, such as B D (fig. 9). We have :

$$\text{B D} = \text{C D} - \text{C B} = \text{C G} + \text{G D} - \text{C B},$$

$$\text{C G} = \frac{\overline{\text{T G}}^2}{2 \text{ R}}, \ \text{C B} = \frac{\overline{\text{C H}}^4}{24 \text{ R}l^2}$$

If we take the point of osculation H as origin of the abscissae, we have :

$$\text{C H} = x, \ \text{T C} = (l - x)$$

Furthermore,

$$\text{T T}' = \text{E T}' + \text{E T} = 2 \text{E T}'$$

since

$$\text{E T}' = \frac{l^4}{24 \text{ R}l^2} = \text{T E},$$

from which :

$$\text{T T}' = \frac{2\, l^4}{24 \text{ R}l^2} = \frac{l^2}{12 \text{ R}} = \text{G D}.$$

Finally,

$$\text{B D} = \frac{(l - x)^2}{2 \text{ R}} + \frac{l^2}{12 \text{ R}} - \frac{x^4}{24 \text{ R}l^2}$$

We will note that the third term of the second component is equal to the ordinates of the part A E of the curve, these ordinates having already been calculated.

Tangent at E.

The angular coefficient of the tangent at E of the alignment A F E (fig. 9) is equal to :

$$\frac{dy}{dx} = \frac{4\, x^3}{24 \text{ R}l^2} = \frac{l}{6 \text{ R}}$$

for $x = l$.

The angular coefficient of the tangent

at E of the alignment H B E is equal to :

$$\frac{dy}{dx} = \frac{2\,(l - x)}{2\text{ R}}\,(-1) - \frac{4\,x^3}{24\text{ R}l^2} = -\frac{l}{6\text{ R}}$$

for $x = l$.

The two alignments have thus the same tangent at E, if we consider that the abscissae reckoned from H are negative, the abscissae reckoned from A being positive.

Disengagement of the straight section or the osculatory circle of radius R from the transition curve.

We now refer to figure 9. The straight line M T, tangent at T to the arc of circle with radius R is laid parallel to Ax to allow the laying out of the transition curve A H.

We know now that :

$$\text{E T} = \text{E T}' = \frac{l^4}{24\text{ R}l^2} = \frac{l^2}{24\text{ R}}.$$

Consequently, the straight line M T is displaced parallel to itself from :

$$\text{T T}' = \frac{2\,l^2}{24\text{ R}} = \frac{l^2}{12\text{ R}}$$

For :

l = 100, R = 500, T T′ = 1.67

We can also displace the circle of radius R by the same amount as shewn in figure 11.

Lay-out of the transition curve by the aid of an auxiliary arc of circle of radius R′ < R.

The displacement of the straight lines parallel to themselves is possible only in the construction of new lines. Otherwise, when a curve of circular arc of very long development is located on the line operated, it is preferable not to displace the whole curve parallel to itself. For this purpose, a solution can be used similar to that used for parabolic curves which we shall explain.

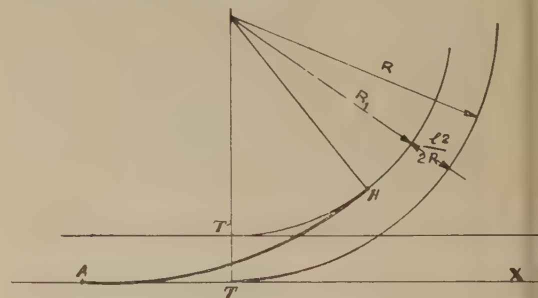


Fig. 11.

Take (fig. 12) a circular arc T N of radius R, tangent at T to the straight line A X, to be joined to the latter, by a transition curve, subject to the displacement of this arc over a length T B = q only, for example.

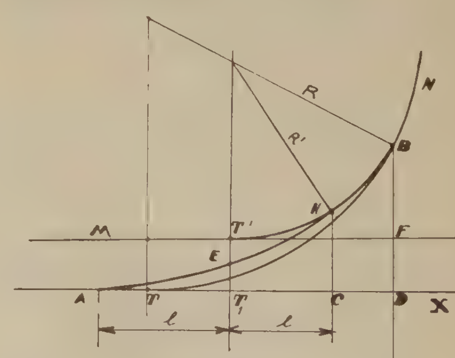


Fig. 12.

For this, at point B we describe a circular arc B H T′ of radius R′ < R, tangential to the circle of radius R at B

and in such a way that, at T′, its tangent T′ M is parallel to the straight line A X.

We know that we can connect the arc T′ H B of radius R′ to the line A X by the use of a transition curve A H, having for equation :

$$y = \frac{x^4}{24\ R' l^2}.$$

This connection will pass through the centre of T_1 T′. If H is its point of osculation with the circle of radius R′, we have :

$$A\ C \approx A\ H = 2\,l,\ A\ T_1 = T_1C = l,$$

$$T'\ T_1 = \frac{l^2}{12\ R'}.$$

We have thus substituted for the line A T B, the line A E H B.

We now calculate T T_1 and the relationships which should exist between l and q to make this solution possible.

For this purpose we draw the curvature diagrams of the curves T B, A H B and T′ H B (fig. 13).

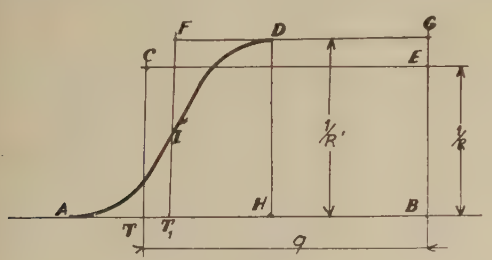


Fig. 13.

These are : the rectangle T C E B for the line A T B, the area A I D G B for the line A E H B, the rectangle T_1 F G B for the line T′ H B.

The lines A T B and A E H B, having the same ends, have the same total versines, consequently, the areas of their diagrams of curvature are equal and T C E B = A I D G B.

The transition curve A E H being osculatory to the circular arc T′ H B of radius R′, the areas A I T_1 and I F D are equal and T_1 F G B = A I D G B = T C E B, or :

$$q \times \frac{1}{R} = (q - T\ T_1)\ \frac{1}{R'},$$

from which :

$$T\ T_1 \times \frac{1}{R'} = q \times \frac{1}{R'} - q \times \frac{1}{R}$$

$$T\ T_1 = q\ \frac{\left(\frac{1}{R'} - \frac{1}{R}\right)}{\frac{1}{R'}} = q\left(1 - \frac{R'}{R}\right)$$

Since this fixes q, the disengagement T T_1 from the tangent point T is constant; whatever the value of the radius R, it depends only on the ratio $\frac{R'}{R}$. Let us calculate the ratio $\frac{q}{l}$. For this purpose, we will calculate the ordinate y_B from the point B, in relation to the axis A X (fig. 12). We have :

$$y_B = B\,D = \frac{q^2}{2R}\ \text{(line TB)}$$

furthermore,

$$y_B = B\ D = T_1 T' + B\ F = \frac{l^2}{12\ R'}$$

$$+ \frac{(q - T_1\ T)^2}{2\ R'}\ \text{(line T′ H B)}$$

We therefore get :

$$\frac{q^2}{2R} = \frac{l^2}{12\,R'} + \frac{(q - T\,T_1)^2}{2R'}$$

$$\frac{l^2}{12\,R'} = \frac{q^2}{2R} - \frac{(q - T\,T_1)^2}{2R'} = \frac{q^2}{2R}$$

$$- \frac{\left[q - q\left(1 - \frac{R'}{R}\right)\right]^2}{2R'} = \frac{q^2}{2R}$$

$$- \frac{\left[q - \left(q - q\,\frac{R'}{R}\right)\right]^2}{2R'}$$

$$= \frac{q^2}{2R} - \frac{\left(\frac{q\,R'}{R}\right)^2}{2\,R'} = \frac{l^2}{12R'}$$

since :

$$T\,T_1 = q\left(1 - \frac{R'}{R}\right)$$

This gives :

$$l^2 = 12\,q^2\,\frac{R'}{2R} - 12\,q^2\left(\frac{R'}{R}\right)^2\frac{R'}{2R'}$$

$$= 6\,q^2\left[\frac{R'}{R} - \left(\frac{R'}{R}\right)^2\right]$$

$$\text{or } \frac{q}{l} = \frac{1}{\sqrt{6\left[\frac{R'}{R} - \left(\frac{R'}{R}\right)^2\right]}}$$

We shall note that the two transition curves of the special type which we have just considered located at the ends of a circular curve, may have different lengths whilst the normal transition curves must be equal. The ratio $\frac{R'}{R}$ is calculated in relation to the speed of trains by the formula :

$$f_{R'} - f_R = \frac{8.6}{V^2}$$

(V = speed in m/sec) [1] which gives the possible difference between two successive versines of two tangential circular arcs so that the junction at the tangent point may be imperceptible to a passenger; f_R being the versine of the circular arc of radius R and $f_R{}'$ that of the circular arc of radius R′. For example, for :

$$l = 100 \text{ m}, \frac{R'}{R} = 0.95,$$

we find

$$q = \frac{100}{\sqrt{6 \times 0.05}}$$

= 182 m 48, $T\,T_1$ = 182 m 48 × 0.05 = 9 m 10.

Improving the entrance to and exit from a parabolic curve by a transition curve.

Let us consider figure 3. We have seen that O J = J T, O T = T H, from which O T = 2 J T = J N and O H = 2 O T = 2 J N.

The transition curve has therefore a length double that of the parabolic curve; it may therefore be impossible to lay out a transition curve. In this case, we must be content to break up, the angles at A, A′, B, B′ by tracing in each of these angles a partial transition curve of a length equal to $\frac{4p}{3}$, for example, as shewn in figure 14.

(1) *International Railway Congress Bulletin* for September 1930, « Railway Curves. — Parabolic curves », J. CHAPPELLET. — Publishers : Eyrolles, Paris.

However, it is indispensable that the entrance to and exit from the curve comprise the same transition curves so that the centres of gravity of the diagram of versines (or of the curves) retain the same abscissa. If this was impossible, the balance of the versines (sum of the versines and sum of the moments of the versines) could be obtained only by modifying the layout in the circular part.

on the other hand, and the entrance to the superelevation slope is not graduated, which is the reason for a transition curve.

Demonstration of the formula: $Y = \dfrac{x^4}{24\ R l^2}$

without integral calculus.

Let O B D (fig. 4) be the diagram of curvature of a transition curve, osculatory

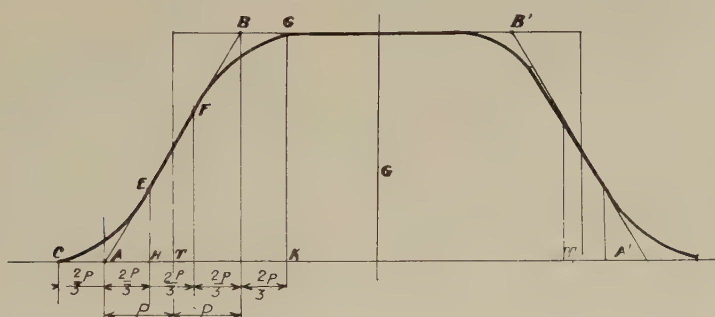


Fig. 14.

Note. — The transition curves have the same defect of a difficult achievement of superelevation which no longer runs progressively, and of greater care in track maintenance and in the retention of the levelling posts in their original theoretical position.

Having stated this, it is necessary to condemn the practice of breaking down angles such as A by a diagram of versines, often designed by appearance having the form of the diagram of versines C E F G and of realising a superelevation which runs progressively from C to K (fig. 14). In this case, we distort the parabolic curve which from the point of view of curvature gives every satisfaction, since it is osculatory to the straight line on the one hand, and to the circle of radius R at O to a straight line, and at H to a circular arc of radius R, we have :

$$B\,T = \frac{1}{2} \times \frac{1}{R}.$$

We propose to calculate the ordinate from a point L situated at a distance x from the start O. At the point L the curvature is equal to $\dfrac{1}{R_x}$ (fig. 15).

We know that the ordinate of the

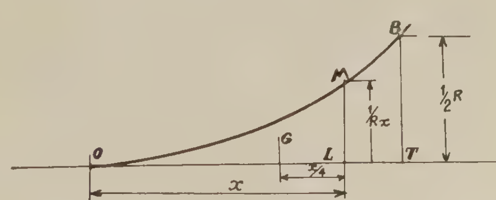


Fig. 15.

transition curve at the point L is equal to the moment of the area O L M (diagram of curvature from O to L in relation to point L) (1). O M being a parabola of the second degree, we have :

Area :

$$\text{O M L} = \frac{1}{3}\,\text{O L} \times \text{M L} = \frac{1}{3}\,x \times \frac{1}{R_x};$$

and for the same reason, the abscissa of the centre of gravity of the area O L M is equal to $\frac{x}{4}$.

We therefore have

$$Y_L = \frac{1}{3}\,x \times \frac{1}{R_x} \times \frac{x}{4} = \frac{x^2}{12} \times \frac{1}{R_x}$$

We have seen that (p. 538), the superelevation at point L is equal to :

$$S = \frac{C}{R_x} = \frac{I}{2l}\,x^2.$$

(I maximum superelevation slope).

The curvature at the same point can be :

$$\text{M L} = \frac{1}{R_x} = \frac{\frac{C}{R_x}}{C} = \frac{\frac{I}{2l}}{C}\,x^2 = \frac{I}{2lC} \times x^2$$

but :

$$I = \frac{C}{Rl},$$

from which :

$$\frac{1}{R_x} = \frac{\frac{C}{Rl}}{2lC}\,x^2 = \frac{1}{2Rl^2} \times x^2.$$

Finally :

$$Y_L = \frac{x^2}{12} \times \frac{1}{R_x} = \frac{x^2}{12} \times \frac{1}{2Rl^2}\,x^2$$

$$= \frac{x^4}{24\ Rl^2}$$

(1) *International Railway Congress Association* for September 1930, « Railway Curves. — Parabolic curves », J. CHAPPELLET. — Publishers : Eyrolles, Paris.

[**656** .225 (43) & **656** .261 (43)]

The new large container service of the German Railways,

by the General Manager's Department of the German Federal Railways.

(Containers, No. 4, December 1950.)

PART I.

1. Bases of the service.

Beside the small container service, the former « Reichsbahn » had for some time made every effort also to develop the door-to-door service by large containers.

But whereas the small containers were received by the public with increasing favour from the very first, the employment of large containers has never got beyond the initial stage, in spite of all efforts.

Two principal causes were at the root of this situation :

— the technical features of large containers, of which the greater number were suitable for road traffic, did not give satisfaction;

— the cost of the loading and unloading operations, as well as collection and delivery at the destination, was too high.

After the war, and with increasing road competition, the question of achieving a door-to-door service for goods without transhipment became once more an acute problem.

An exhaustive investigation of the problem and the verification of the good results secured by the tests carried out by the Dutch Railways with their own system of large containers, led the D. B. to renew their attempts to put new large containers into service.

The two drawbacks mentioned above are eliminated. The new large containers are no longer required to travel by road. They are simply fitted with rollers and placed, three at a time, on flat trucks. Each of them is placed on a runway, without the necessity of using a slope, by means of a loading appliance forming part of the D. B.'s road vehicle. This vehicle and its loading appliance enable the container to be loaded on the truck and unloaded from the truck; it also enables the container to be placed on the ground or raised from it.

Although the German large container system is, in principle, based on the Dutch system, it differs from the latter on several important points. These differences are governed by considerations of construction technique and general economics, or arise out of the transport situation in Germany.

In spite of these differences, the interchangeability of the D. B. equipment is amply assured; the German containers can be loaded on Dutch trucks, just as they are; moreover, whether they make use of German or Dutch trucks, these containers can be handled equally well by Dutch or German road haulage vehicles (semi-trailer and corresponding tractor). The same remark applies reciprocally to Dutch containers.

2. Containers and carrier lorries.

As a first stage, the D. B. put 1 000 large containers into service (250 open and 750 closed), as well as 333 carrier trucks and 50 road haulage vehicles.

For a tare of less than 1 ton, the containers take a load of 5 tons, which must not be exceeded by more than 5 %. The

dimensions of the containers are as follows :

Class	Make	Capacity (cubic feet)	Inside measurements		
			Length	Width	Height
Closed	Epa	420	9′ 6″	6′ 3″	6′ 6″
Open	Epao	280	9′ 10″	5′ 10″	4′ 7″

The construction of these containers is in accordance with international regulations (U. I. C. Leaflet No. 111) as well used for conveyance by vessel or handling on unfavourable ground.

The closed container, lightly constructed of welded steel, has a three-leaved door on each of its small sides; the two upper leaves, with vertical hinges, can be opened to an angle of 270°; the lower leaf, with horizontal hinges, can be let down and used as loading platform for filling or emptying the container (e.g., with a wheelbarrow); this lower leaf is removable.

The container is easy of access. The inside walls have smooth surfaces, which enables them to be kept spotlessly clean and allows goods to be conveniently

Fig. 1. — Large closed containers secured to truck.

as the new regulations laid down for transit by road under Customs control.

With a full load, they can sustain colliding impacts at 10 m.p.h. without any permanent distortion.

Once they are closed, they have no removable parts other than the runners

stacked; for goods which cannot be stacked, fixing lugs are provided inside the containers.

Closed containers have a wooden floor and are fitted with ventilation openings which can be closed up.

The walls of the small sides of the *open*

containers are hung on an axle which acts as a hinge round which they can swing for opening after the bottom locking device is unbolted; thus, goods in powder form can be very easily discharged. These walls are detachable.

The top of open containers is provided with removable hoops capable of holding a tarpaulin for protecting goods from damp and pilferage.

steadying hooks and flat tightener securing rods, greatly resembles the Dutch system.

There is, however, in the initial stage, a model which is recognised, even by foreign railway representatives, as being more practical and more to be recommended.

It enables the container to be hooked on and unhooked with a very small number of handlings, carried out solely from the road side; it keeps the road haulage vehicle sta-

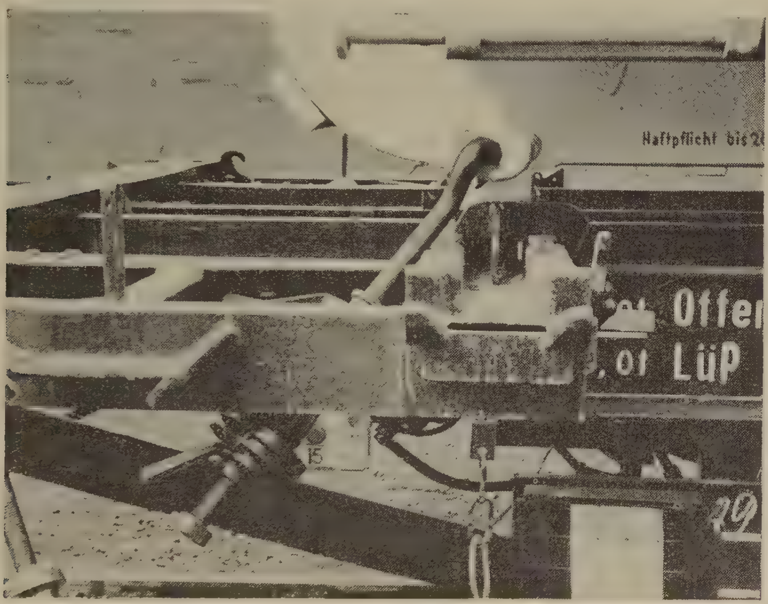


Fig. 2. — Method of securing large open containers on truck.

In addition to these two fundamental models of containers, *special containers* can be constructed, such as insulated containers, refrigerating containers, tank containers, etc.

For conveyance by rail, the containers are — with a reduced amount of handling — placed in threes on specially designed *carrier trucks*, capable of being attached to express trains.

The fastening of the containers on the carrier truck by means of moveable cleats,

tionary during handling, and obliges the handling personnel to fix the container securely on the carrier truck.

The securing rods, at present free, are fixed to the truck by a joint; in this manner there is no longer any danger of their being mislaid.

The external frame members of the existing German carrier trucks are interrupted under the containers between the guide rails; the securing parts of the containers are thus made more easy of access.

It is advisable that carrier trucks and containers do not form a single unit, so that the maximum flexibility in their utilisation can be guaranteed.

In the event of carrier trucks being expected to travel empty or partly loaded, the securing rods of these trucks which are not being used can be fastened by means of special devices.

Fig. 3. — Special trailer. General view.

3. Road transport haulage devices.

The German vehicles used for moving containers about on the road are in a state of decided evolution. They convey the container at a speed which reaches 37 m.p.h., either for tractors with trailers or semi-trailers. They are provided with equipment for loading, unloading and transhipment, which also enables emptying by tipping.

If there was a necessity for designing a road haulage vehicle specially intended for containers, there was also a useful purpose in seeking to achieve a vehicle retaining the features of an ordinary platform lorry and fitted with simple parts enabling a container on the ground or on a railway truck to be loaded on it, as well as tipping it.

In this way, a limited number of two models of road vehicles were first of all tried out.

Special trailer. — In order to be able to utilise existing types of tractors, this model was made as a twin-axle trailer.

However, as it is very difficult to back a trailer exactly opposite to a container, especially when the latter is placed on a truck, this model was fitted with a pivoting dummy undercarriage, capable of receiving its load either from the rear or from either of its sides. This arrangement presents, moreover, the advantage of requiring less space for manœuvring in railway yards or at customers' premises where space is often restricted.

For transferring the load, a cable wound on a drum is used, operated by a Bosch

electric motor. The current is supplied by a 36-volt battery which can be charged by directly utilising any lighting plug.

Moreover, the vehicle under consideration affords the advantage of justifying its cost as a trailer, if completed by means of 5-ton platform lorries, with 107 sq. ft. surface, which are adapted, as easily as the containers, to being loaded, unloaded or tipped, and which form an inexpensive supplementary equipment which can be kept in reserve in any quantity and quality. The trailer thus arranged can, in the event of the absence of containers or in addition to the latter, be used economically and advantageously; actually, owing to the mobility and ease with which the platform lorry can be turned about, it is better than road haulage vehicles of ordinary construction, and can be used in varying circumstances with a high output.

This model was designed in cooperation with the Weser A. G. of Bremen. The test models were constructed by this firm. Photographs Nos 3, 4 and 5 show this vehicle.

Ordinary trailer fitted with a special device for transhipping containers.

This vehicle is intended for localities where a special trailer could not apparently be made full use of. It will do the work of containers and also carry out other work.

Owing to its better handling qualities, the semi-trailer system was chosen. As tractor, a shortened chassis is now used, fitted with an 85 HP air-cooled Diesel motor.

The loading platform provides a large available surface running from end to end and enabling a load of 6 tons to be carried.

With this vehicle, the transfer of the container is obtained by means of a jointed chain which is housed in the loading platform. By means of this chain, the container can be both pushed or pulled and even tipped towards the rear by means of a simple device. The jointed chain is operated by the motor of the tractor by means of a mechanical power connection.

The photographs 6 and 7 show this vehicle, which has been worked out with the firm of E. H. v. Lienen, of Bochum. This firm also constructed the first trial models.

Beside these two models of road haulage vehicles, other types are being tried out, some representing the development of ideas already put into practice, the others being innovations.

When the latter have been perfected, the D. B. will issue a report about them.

The securing of the containers on the road haulage vehicles has been standardised.

The containers run on shallow U-irons. At each of their bottom corners they are fitted with a lug, into which a steadying hook fits which is fixed to the vehicle and tautened by screwing.

4. Carrying out the service.

When road haulage vehicles are put into commission for test purposes, in order to secure the necessary information from the experiments carried out, the railways themselves take charge of the delivery and collection of containers at the client's premises.

The new large containers are placed at the public's disposal as a means of transport belonging to the railway; this arrangement is made apart from the transport contract and without being subject to the conditions of tariff application.

Prior to the first utilisation, the consignor must sign an agreement accepting the utilisation conditions which are submitted to him by the railway.

The transport charge is reckoned on the net weight of the goods. No charge is made for using the container. For delivery and collection of the container at destination or departure point by the railway services, only a minimum charge is made, the amount being fixed for each case according to the circumstances. The employment of containers is also authorised when the consignor or consignee owns a private siding.

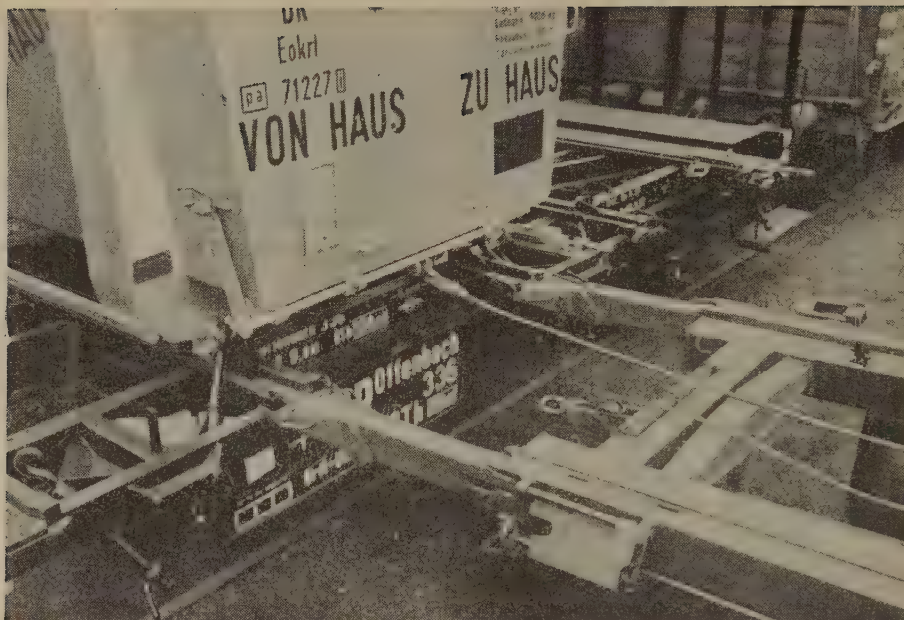


Fig. 4. — Special trailer. Connection with truck.

Fig. 5. — Special trailer. Depositing open container on ground.

(Photo by Ernst Below. Pressedienst HVB.)

Fig. 6. — Specially fitted semi-trailer. Loading on truck.

(Photo by Ernst Below. Pressedienst HVB.)

Fig. 7. — Specially fitted semi-trailer. Unloaded on ground.

The employment of closed containers is advisable for the conveyance of all goods requiring protection, insofar as these goods are not excluded from this method of transport owing to their exceptional dimensions.

Open containers can be employed for solid and less delicate goods, more especially for pulverulent materials. No charge is made for supplying tarpaulins for protecting the goods in open containers from the rain.

The containers which were shown with their handling devices, by two exhibition trains over the whole of the D. B. system at all the points concerned aroused the greatest interest everywhere.

As a first stage, the service by containers will be carried out in the relations between railway centres with a heavy goods traffic, as well as in certain given special relations.

At these stations the first 50 road haulage vehicles will be attached for delivery and collection in the immediate vicinity or near-by localities.

It will not be possible until later to give details about the importance of each volume of traffic, as well as the use made of containers and road haulage vehicles; actually, the experiment is only about to commence.

In any way, the D. B. hope, by the large container service, to have provided for the transport industry, a means of speedy rotation and multiple utilisation, to effect a saving in packing, protection from breakage and pilferage, and offer a vehicle that is equal to — if not better than — the lorry.

It will only be when the traffic tests have finished that it will be possible to judge of the measure in which the traffic by large containers can compete with the lorry for conveying goods.

PART II.

The new large container traffic of the German Federal Railways is a complete success.

Statement issued by the General Manager's Department of the German Federal Railways, Offenbach.

(Containers, No. 6, December, 1951.)

Facts ascertained about the traffic.

The development of the new large container traffic of the German Federal Railways (vide « Containers » Review No. 4) distinctly shows in 1951 the passage from the doubtful experimental stage to a successful one; this is a point which, without any quibbling, may now be considered as settled, without even waiting for the results of the autumnal traffic to be made known.

After the elimination of certain difficulties to begin with, applications for new large containers have, for some time already, been so great that it has not been possible to satisfy them all. It has been shown that the basic effective of 1 000 containers (750 closed, 250 open) and 50 road haulage appliances, is much too small to enable this new method of transport to reveal the full proof of all its advantages, considering the extent of the German railway system as well as the topography of the country, which involves a wide dispersion of traffic. More especially, the number of open containers available is far below what it should be to enable public requirements to be satisfied, even approximately.

This situation arises out of the fact that the saving which can be effected by consignors in using containers, is considerable. This advantage is particularly apparent for conveying cement in bulk in open tarpaulin-covered containers, as well as for bulk loading of raw sugar and other raw materials having a certain value; in the absence of containers, such consignments would require paper or jute bags for packing, which would represent a large part of the transport expenses. The placing of a supplementary order for 1 000 containers in 1951 is the sequel to this situation.

According to the experience of the German Federal Railways, the possibilities of

employing open or closed containers apply to more than 80 kinds of goods, which, proportionally, are as follows :

Conveyance in closed containers :

Cement in sacks	13.8 %
Window glass	11.4 %
Zinc in sheets	8.5 %
Cereals in sacks	7.0 %
Lead	6.5 %
Biscuits	4.4 %
Pumice stone	4.2 %
Unclassified stone	4.1 %
Artificial fertilisers	3.3 %
Furniture	2.8 %
Wireless sets	2.3 %
Copper sulphate	1.9 %
Glass articles	1.7 %
Hot water tanks	1.6 %
Bacon	1.4 %
Cut stone	1.4 %
Preserved foodstuffs	1.3 %
Ceramic tiles	1.1 %
Chemical products	1.1 %
Foundry products	1.1 %
Other goods	19.1 %

Conveyance in open containers :

Cement in bulk	33.3 %
Cereals in bulk	22.2 %
Sand	7.8 %
Lime	6.9 %
Pumice stone	6.7 %
Gravel	5.5 %
Foundry products	4.85%
Unclassified stone	2.8 %
Slates	2.7 %
Kaolin	1.9 %
Artificial fertilisers	0.9 %
Other goods	4.45%

In spite of the small number of containers available, the foreign traffic is that which has more especially developed. It has accounted for an average of 15.5 % of the total traffic. About 4/5ths of this proportion has been utilised in traffic to the Netherlands. Then come traffic with Belgium, Great Britain, Switzerland, Luxemburg, the Saar, France.

Technical developments.

Under present traffic conditions, the use of tarpaulins over removable slats when employing *open containers*, has given rise to disappointments. Actually, the tarpaulins are subjected to very hard wear; furthermore, the removable parts are easily mislaid.

Under these conditions, it was resolved, for open containers, to resort to the construction of covers whose two halves can be folded back over one of the end walls of the containers; furthermore, the containers are filled through two round openings made in each half of the cover and fitted with plugs which can be locked.

The replacement of most of the tarpaulins by covers of this kind is under consideration.

Also, special attention is paid to making the containers weatherproof, so that they can be used for conveying pulverulent or finely granulated materials.

Finally, it is proposed to fit the swinging end walls with special openings for emptying the containers.

Prototypes of *special containers* are being constructed for conveying liquids as well as for consignments under controlled or very low temperatures.

The supply of special containers must be left, in the first place, to be met by the users, who will receive a proportional subsidy from the German Federal Railways.

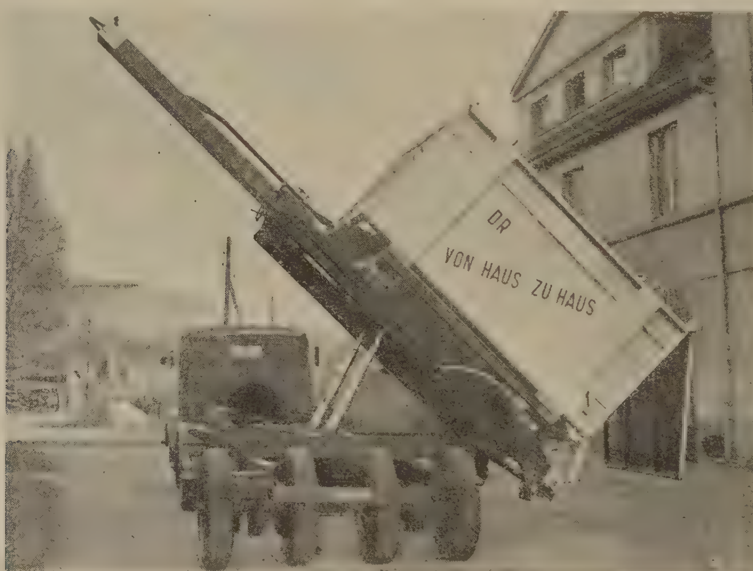
Some tank containers for chemical products will most probably be put into commission at the end of this year by an important firm in the chemical industry.

The *Road haulage appliances* intended for the cartage of containers have been utilised for this particular purpose in very varying proportions, owing to the large proportion of private sidings and traffic with foreign countries.

The number of road haulage appliances existing is provided for in order to cover, without difficulty, the cartage requirements of a fleet of large containers (750 closed

and 1 250 open). Furthermore, at points where the traffic was heaviest, an appliance has been put into service whose construction is best adapted to a continuous intensive service.

This is an entirely hydraulically operated road haulage appliance for containers, constructed by the Ackermann firm, of Wüppertal-Vohwinkel. Amongst its principal advantages, this appliance is capable of being operated by one man, even in the weight of the container is shown by a hydraulic manometer. The road haulage appliance can be loaded or unloaded at the rear or both sides; tipping can take place in the same three directions; the tipping angle is 42°. In order to reduce the length of the cylinder operating the drawbar to a minimum, the latter telescopes automatically. The operation of the appliance is controlled from the rear of the left side of the semi-trailer.



Ackerman road haulage appliance.

event of the most intensive utilisation, which circumstance reacts most favourably on running expenses.

The Ackermann road haulage appliance is a semi-trailer, whose pivoting and tipping chassis is constructed of very tough electrically welded steel. In order to be able to pivot for 90° to the right or left, the pivoting chassis can be raised one foot. The extension of the tipping chassis to the ground is ensured by means of sliding rails. All these parts are hydraulically operated. When the pivoting chassis is raised, the

The road haulage appliances described in No. 4 of the « Containers » Review [1], which have been in service for about a year, have reached a daily output of 20 containers, and even more. In districts where, as a general rule, there is only a small number of large containers to be carted, the road haulage appliances, in addition to

(1) Special trailer, constructed by the A. G. Weser, of Bremen and ordinary lorry fitted with a special device for containers, constructed by E. H. v. Lienen, of Bochum.

the special container service, carry out general services compatible with their method of construction, for somewhat similar work.

The *stations and places* where cartage of large containers takes place by means of haulage appliances belonging to the German Federal Railways, are shown in a special list. At present, about 1 000 stations can be served in this manner. This arrangement is necessary, above all things, so that — owing to the wide dispersion of traffic — customers can take advantage of a maximum number of forwarding and receiving points, which containers can reach by road. In actual practice, however, there is only a relatively small number of possibilities offered which are made use of.

It is expected that the development of the use of large containers will involve a larger concentration on certain heavy traffic streams. Undoubtedly, we must then anticipate the extension of the container road service to numerous stations and places which, in normal times, have little cartage traffic.

In spite of the short duration of the experiments carried out up till now, we can nevertheless conclude from them that the traffic by large containers, on the whole, offers great possibilities of development in Germany.

[656 .212 (73]

Five acres under one roof...

Modern freighthouse at St. Louis.

Missouri Pacific constructs consolidated facility to replace two old, outmoded structures, thereby assuring important benefits for itself and its shippers.

(Railway Age, January 7, 1952.)

The new freight station as seen from the air. The headhouse, fronting on Miller street, is in the right foreground. Tracks in left foreground are part of Lesperance Street yard.

Shippers of freight on the one hand and railroad engineering officers on the other will both find much to attract their attention in the \$ 1 3/4 million freighthouse that the Missouri Pacific has just finished at St. Louis, Mo., and which was opened for service on January 2.

Shippers and receivers of freight will welcome the new facility because it will not only expedite the handling of freight by concentrating under one roof the work formerly done at two stations located about a mile apart, but is also expected to result in a material reduction in loss and damage because shipments will be handled fewer times. Also contributing to faster and better service will be the utilization at the new freighthouse of a large assortment of mechanical equipment, and the availability of modern communication facilities.

Railway engineering officers, on the other hand, will center their interest in the unusual structural characteristics of the new facility. Among these is the fact that the entire warehouse and platform areas, and the tracks serving them, comprising a total of about five acres, are under roof, the openings at the ends for the tracks being enclosed with rolling doors of the type used in airplane hangars.

Among other noteworthy features are the use of the rigid-frame principle in the design of the roof-supporting structure, the use of stud welding in fastening the corrugated Transite roofing and siding to the steel members, and the provision of crossover bridges of a special design, which are retracted under the platforms when it is necessary to clear the tracks to permit cars to be switched. Engineering officers of many other railroads will be particularly interested in the fact that the new facility was built almost in its entirety by the railroad's own forces.

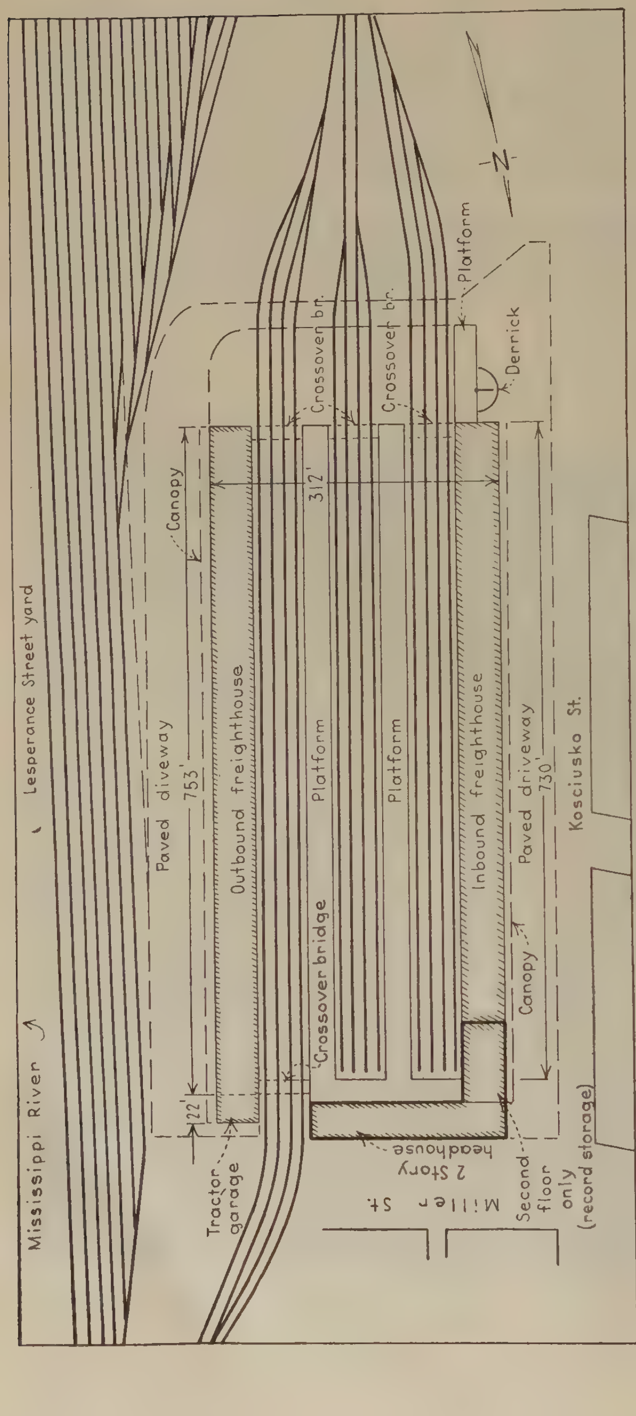
The two existing freighthouses that have been replaced by the new structure are the Gratiot Street and the Poplar Street stations. The first of these is located at Main and Gratiot streets and was built prior to 1888 as the St. Louis freight terminal of the old St. Louis, Iron Mountain and Southern, now part of the Missouri Pacific. Generally speaking, all freight destined to or received from the south and southwest was handled through this facility.

The Poplar Street station at Poplar and Seventh streets was built in 1879 by the Missouri Pacific. All package freight traffic to and from western points was handled through this station.

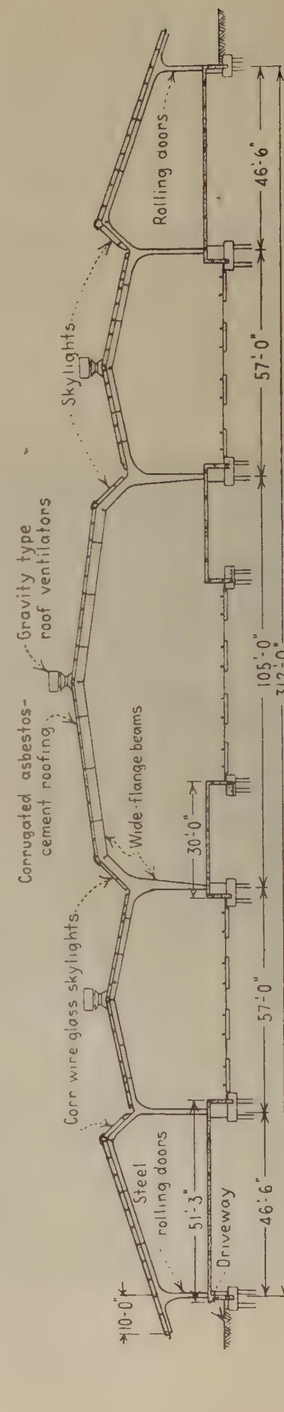
Serious disadvantages were experienced by the railroad because of the use of the two freighthouses. Although the bulk of the business moving through each of them was destined to or originated on different lines of the railroad, it was not uncommon for shippers to make delivery of shipments for mixed destinations at one of the stations. When this happened the railroad either had to transfer part of the freight by street truck or transfer car to the other station, or, if the quantity of merchandise involved was sufficiently large, a car was loaded for a destination out of the territory normally served by the particular freighthouse. The crosstown transfer of freight between the two freighthouses, which was the method normally employed, was not only expensive but involved delays in dispatching shipments. Another disadvantage of the old freighthouses was that they were both outmoded in design and arrangement and were expensive to operate and maintain.

To overcome the disadvantages inherent in the operation of two separate freighthouses, the railroad decided to consolidate its freight-handling operations at St. Louis in a single modern facility. The site chosen for the new structure is on property already owned by the railroad and is adjacent to the Missouri Pacific's Lesperance Street yard which extends along the west bank of the Mississippi river. This is the switching yard for freight traffic moving to and from the south and southwest.

The new freigthouse fronts to the north on Miller street and is flanked on the west



General layout of the freight station, which is in the center of an extensive southside industrial area.



Typical cross-section through the freighthouse, showing the rigid-frame construction of the roof-supporting structure.

by Kosciusko street and on the east by the Lesperance Street yard. Up to a point the arrangement is typical of other modern freighthouses, with a two-story head house fronting on Miller street and with the freighthouses and platforms extending to the south, which are served by tracks that enter the area from that direction. The the other (and here is where the arrangement deviates from the conventional) extends entirely through the freighthouse. The through tracks are the ones that lie between the outbound freighthouse and the adjacent transfer platform. These tracks extend north of the new freighthouse to a connection leading to the

Looking south along the four central stub-end tracks between the two transfer or island platforms.

inbound freighthouse is on the west and the outbound freighthouse is on the east (both are about 51 ft. wide), and in between there are two island transfer platforms each 30 ft. wide. All the platforms are approximately 750 ft. long. They are served by three groups of four tracks each. Two of the track groups are stub end, but Twelfth-Twenty-Third Street yard, which is the switching yard for freight to and from the west.

The freight-handling platforms of the new station have concrete decks supported on sand fill confined between concrete retaining walls. The concrete floors were treated with a metallic hardener to increase

resistance to wear and to minimize dust formation. The retaining walls are supported on concrete footings founded on creosoted timber piles ranging in length from 35 to 45 ft. Foundations of this type were required because the entire facility is located on fill material placed over an old slough. A total of 1 680 timber piles was required in constructing the footings.

The warehouse portion of the building has a structural-steel frame which, as previously stated, is of rigid frame design, thereby assuring economy in construction and a minimum of column supports to interfere with movements on the platform. The structure is comprised of five longitudinal bays the center one of which, extending over the two transfer platforms and the track group between them, has a clear span of 105 ft. between the supporting columns. The principal load-carrying members of this and other bays, all spaced 22 ft. apart, are designed as rigid frames and consist of wide-flange beams. For the center bay 30-in. 108-lb. beams are used, while 18-inch. 70-lb. beams are employed in the adjacent 57-ft. flanking spans, and 14-in. 61-lb. beams are used in the 46-ft. 6-in. end spans. Except for a limited number of « stitch » rivets the structural steel was fabricated by welding.

The roof and the end walls of the warehouse are covered with corrugated Transite fastened to the steel framing with Nelson stud welds. In the roof over each platform there is a continuous skylight of corrugated wire glass. All flashing and gutters are of stainless steel. For ventilation in the warehouse there are three lines of gravity-type ventilators in the roof.

Along both the inbound and outbound sides of the freighthouse the sidewalls consist of practically continuous lines of steel overhead rolling doors, each of which allows 11 ft. of tailboard space for trucks. There are 127 such doors. Spaced every 200 ft. in each sidewall there is a « crash » door to permit the escape of personnel in

« Roll-away » bridges in the fully extended position between the two island platforms. These bridges are motor operated by push-button control.

case of fire. On both sides of the structure the roof overhangs the tailboard space a distance of 10 ft. to provide protection for truck loading and unloading.

To permit ready maneuverability of trucks ample driveway space is provided on both sides of the structure, the driveway on the west, or inbound, side, being 85 ft. wide and that on the east, or outbound, side, 75 ft.

At the south end of the building are three large openings, one for each group of tracks, and at the north end there is a similar opening. All of these openings are enclosed with rolling hangar-type doors. These doors are all motor operated, with push-button controls.

Artificial lighting in the warehouse and platform area is by suspended incandescent fixtures. In addition, for the illumination of the interiors of cars being loaded and unloaded, extension cords with lights are suspended overhead on reels at intervals of 44 ft. on each platform. To permit instructions to be transmitted from the office to personnel on the platforms with a minimum loss of time, a paging system is provided, which is used in conjunction with telephones spaced at strategic intervals.

One of the hangar-type doors, partially rolled back, at the south end of the structure. « Roll-away » bridges are in retracted position under the platforms.

Midway of the length of both the inbound and outbound warehouses is a two-level enclosure, in which the first level is devoted to office space, while the upper level has toilet facilities for employees. These enclosures have plaster walls and ceilings, fluorescent lights and gas-fired unit heaters.

A dry-pipe (non-freezing) fire-protection

system is provided to serve all parts of the warehouse area. Hose stations are installed at strategic intervals, at each of which there are push buttons for starting and stopping the fire pumps in a boiler room in the head house. Further protection against fire is provided by twelve 2 1/2-gal. frostproof fire extinguishers on each platform.

Unusual crossover bridges.

The crossover bridges are one of the most interesting features of the entire layout. These bridges span the track groups at the ends of adjoining platforms. There are four such locations, three at the south end of the facility and one at the north end. These bridges retract under the platforms when it is desired to switch cars over the tracks that would otherwise be obstructed by them. Three of the bridges are single-section units, while the other, which connects the two transfer platforms, was constructed in two sections, each of which retracts under one of the transfer platforms.

Each crossover bridge has a deck 16 ft. wide which consists of inverted T sections filled with concrete. The deck is carried by a structural steel frame on flanged wheels which operate on rails placed transversely with the warehouse tracks. The tracks for the crossover bridges have a gage of 8 ft. 6 1/2 in. and are supported on wood crossties laid on a concrete foundation. The crossover bridges are so constructed that their decks can be lowered as necessary to retract them under the platforms, and then raised to the platform level when they are returned to the operating position.

Each crossover bridge is actuated by two remotely controlled motors, one for hoisting and one for racking. These motors are electrically interlocked, to insure proper operating sequence. Control push button stations and indicating light panels are placed on a column adjacent to the bridge. Where the tracks for the crossover bridges intersect the freighthouse tracks standard bolted A. R. E. A. two-rail frogs are provided. As a protective measure for the crossover bridges a red indicating signal light has been installed on the outside face of end wall over the center line of tracks, which shows a red indication, when the bridge is obstructing the tracks. In addition hand-operated derails have been installed on the approach tracks, which will be controlled (locked or interlocked) by the freighthouse foreman who will also control the position of the track doors and bridges.

Another interesting feature of the track layout is the special concrete bumpers placed at the ends of the track in the warehouse. In each of these posts the striking plate is backed up by eight double-coil freight-car springs with a recoil of 3 in. With this arrangement it is calculated that the bumpers will stop a loaded car moving at a speed of five miles per hour without being damaged.

The handling of merchandise in the new freighthouse will be a highly mechanized operation in which dependence for hauling the merchandise will be placed mainly on three-wheel rubber-tired 2 000-lb. platform trucks. There will be 62 such units, including 20 Hysters, 20 Buda Chore Boys, and 22 Kalamazoo's. Other mechanized equipment will include one 6 000-lb. Yale fork-lift truck, ten 4 000-lb. Clark fork-lift trucks, and one 6 000-lb. Krane Kar with an 18-ft. boom for handling bulky shipments. To facilitate the handling of merchandise with fork-lift trucks 1 000 wood pallets have been provided. In addition, at the outer end of the inbound platform is an uncovered concrete platform on which is located a gantry crane for handling shipments that are too heavy or unwieldy to be moved through the freighthouse in the usual manner. A garage for repairing, servicing and housing the mechanical equipment is provided at the north end of the outbound platform.

Features of head house.

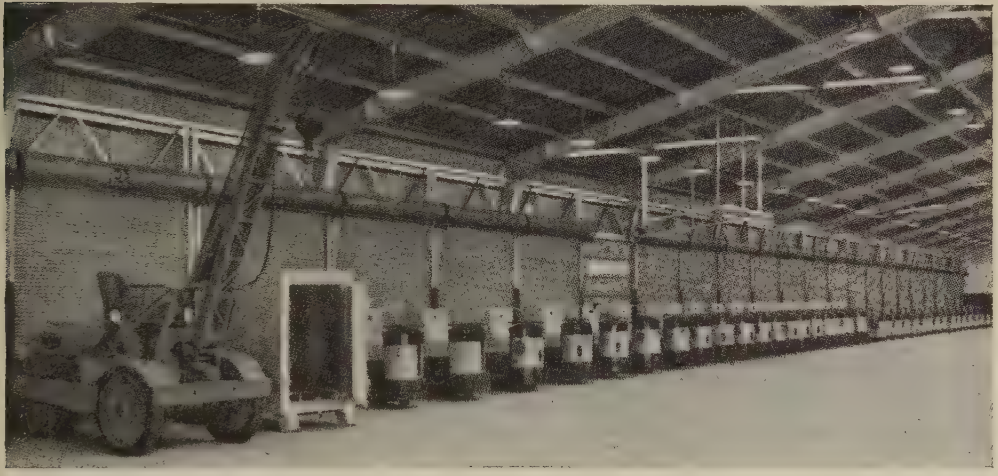
The two-story head house has a reinforced concrete frame and has exterior walls faced with glazed brick of a light

cream color, which is backed up with concrete blocks plastered on the interior. The roof over this structure consists of Kaylo slabs covered with three-ply asbestos built-up roofing.

Facilities on the first floor of the head house include a cashier's office, an office for the agent, a salvage room for storing unclaimed merchandise, separate locker and wash rooms for white and colored men, a cooper shop, a freight storage room for perishable merchandise and a boiler room.

salvage room, the cooper shop and the freight storage room, are all heated by steam unit heaters, while all office space is heated by steam convector type units.

All lighting in the head house is of the fluorescent type and all windows, which have projection type sash, are fitted with venetian blinds. Asphalt tile floors are provided in the office areas, while the wash and locker rooms have Hubbelite floors. Walls and ceilings in the head house are plastered throughout.



Line-up of part of the large fleet of mechanical freight-handling units with which the freight terminal is equipped; 1 000 wooden pallets have also been provided.

The equipment in the boiler room includes a gas-fired steam boiler and a gas-fired hot-water heater with a capacity of 2 700 gal. per hour.

Except for toilet facilities, the space on the second floor of the head house proper consists of a single large general office. In addition, at the second floor level, but extending out over the inbound freight platform, there is a large record storage room in which the floors and roof consist of structural steel encased in concrete. This room, as well as the locker rooms, the

The project for constructing the consolidated freighthouse was initiated under the general supervision of R. P. HART, then chief engineer and now chief operating officer, and was carried to completion under the general direction of his successor, W. H. HOBBS. The plans for the building were prepared under the direct supervision of A. L. BECKER, engineer of structures. The track layout was designed under the supervision of W. H. GILES, then engineer of design, and now assistant chief engineer system — construction.

F. D. WELLS was resident engineer in charge of construction on the ground.

As stated, the facility was constructed in its entirety by the railroad's own forces. The force consisted of six system bridge gangs (under the supervision of J. C. BOSTON, principal assistant engineer), a number of division bridge and building gangs, and a division extra gang which did track work. The average force engaged on the job consisted of about 200 men. The only major aspects of the work not done by company forces were the fabrication of the structural steel which was done under contract by the Stupp Bros. Bridge and Iron Co., St. Louis, and fabrication of the crossover bridges by the Nichols Engineering Company, Chicago.

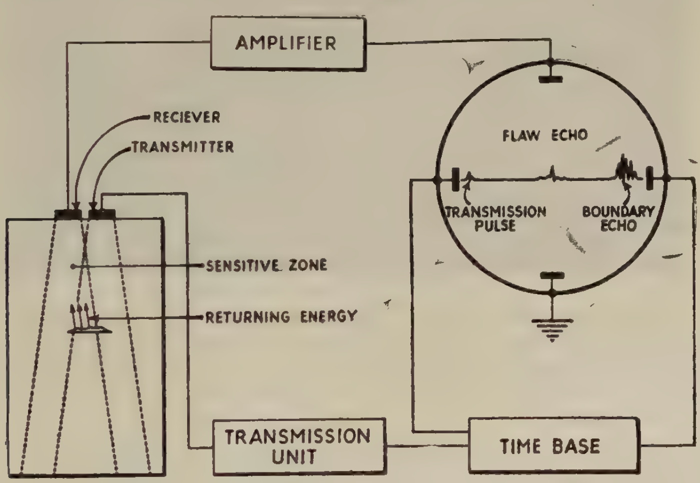
Ultrasonic equipment for metal flaw detection.

Method of locating hidden defects which enables every section of wheels and axles to be inspected without dismantling the bogies.

(By a Correspondent.)

(The Railway Gazette, January 25, 1952.)

In all the principal locomotive and carriage works of British Railways and also in the Acton Works of the London Transport Executive, ultrasonic flaw detectors have become routine testing instruments. This convenient method of non-destructive testing is providing even higher standards of safety for surface and underground rail travel by the location of hidden flaws which cannot be detected by the X-ray method. This lead given by Britain is being followed in other parts of the world, and ultrasonic detectors have since been adopted as standard equipment for railway workshops in, among other countries, France and Argentina.



Schematic diagram of flaw detection apparatus.

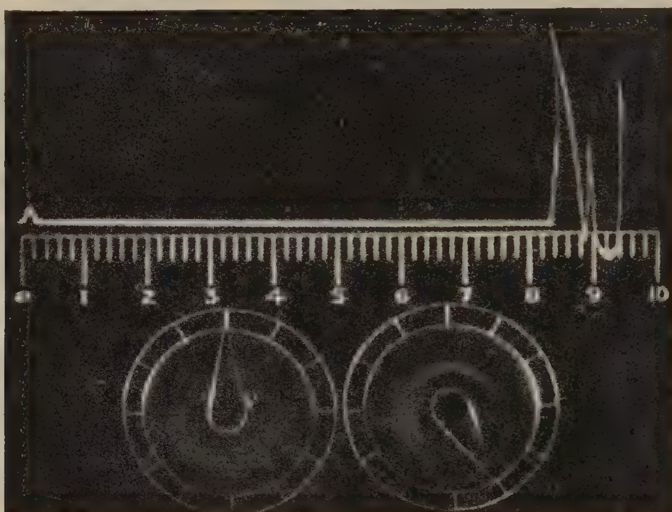
Origin of the method.

Like many other inventions, ultrasonic flaw detection originated during the war, when it became urgently necessary to develop a method of discovering the extremely small hair-line cracks which might cause the failure of armour plate, projectiles, engine parts, raw materials, and so on. In November, 1939, the Hair-Line Cracks Sub-Committee of the Iron and Steel Institute considered reports on the work of Russian investigators, who claimed to be able to demonstrate the existence of cracks in steel by passing supersonic waves through the specimen, and detecting the

shadows caused by the interruption of the beam.

Having had many years of experience with supersonic devices, the firm of Henry Hughes and Son Ltd., now Kelvin and Hughes Limited, was invited to investigate these claims, particularly the Shadow method developed by Pohlman. The investigators soon succeeded in establishing that gross defects could be detected by this method, but that hair-line cracks could not, the reason being that surface irregularities caused far greater variation in supersonic transmission than did small hair-line cracks. Thus the detecting device had to discern a minute diminution in a relatively very large amount of energy despite the presence of large fluctuations caused by surface and other irregularities.

It was evident therefore that a fundamentally different method of approach to the problem was required, and the possibility was examined of using the principle successfully applied by the same firm to the development of echo-sounding apparatus. When soundings are taken by this method, energy is sent out in the form of a very short pulse, concentrated into a narrow beam directed towards the seabed. Should this pulse encounter a submerged object the echo reaches the surface earlier than that from the seabed. In examining a metal specimen for a flaw, the thickness of the metal is equivalent to the depth of the sea, and any defect below the surface will reflect the energy in the same manner as a submerged object in echo sounding, enabling the echo to be distinguished from that reflected from the boundary of the specimen because of its earlier arrival.

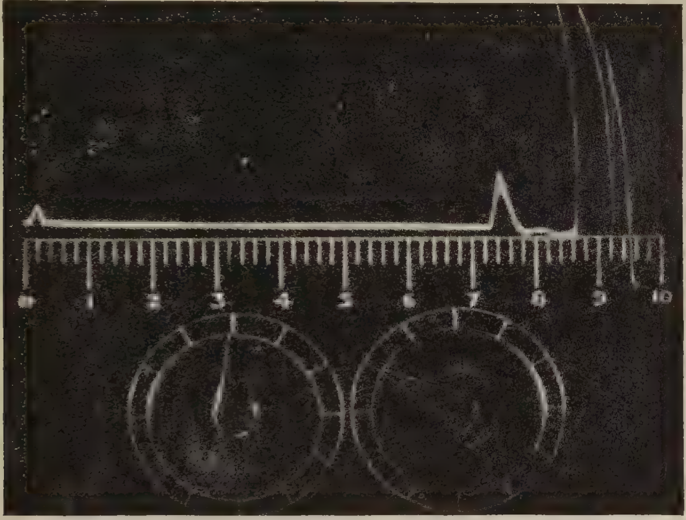


Record of cathode-ray tube showing trace resulting from tests on an unflawed article. The peak on the left is the transmission impulse indicating the surface of the material and that on the right is a boundary echo from the bottom of the test-piece.

Detecting hair-line cracks.

Applied to flaw detection in metal, this

method gave promising results, and it was soon found that, whereas with previous equipment the range of detection even for gross defects was limited to 6 in. to 8 in., the new method could detect minute hair-line cracks at a range of many feet. The apparatus was quickly developed into a portable form and arrangements were made to supply units to the major steel producing plants in Britain. The Ministry of



Record from an unsound test-piece in which the impulse resulting from the flaw appears at a proportionate distance between the transmission and boundary impulses to that of the flaw in the material under test.

Aircraft production then acquired several sets for use in factories producing aircraft metals and instruments were supplied to various research establishments. Conferences between the Hughes research staff and the principal users were held at frequent intervals.

During the past eight or nine years there has been continuous development by the makers, whose team of research workers includes metallurgists, electronic engineers, designers, and fieldworkers concerned with the application side of flaw detection. This work has widened the range of applications by the provision of additional units such as filters, high power transmitters, and special probes. All the essential results of this field research are reflected in the design of improved instruments for flaw detection.

Among the first large users to appreciate the possibilities of ultrasonic flaw detection were London Transport and the British main-line railways. Early experiences by the makers in the field of axle testing included a demonstration given at Acton Works. The representatives of the firm concerned were asked to examine two wheels and an axle and they immediately discovered a large crack directly under the hub of one of the wheels. The probes were then applied to the other end of the axle and confirmed its presence. In some trepidation the engineers reported their findings to the Chief Mechanical Engineer since it seemed improbable that

such a very large defect could exist. They were then informed that, so as to provide a convincing test for the instrument, the axle at the wheel seat had been sawn through, the cut being concealed by the wheel hub so that no evidence could be seen by superficial examination!

Already the British main-line railways were making extensive use of the latest available methods such as X-ray equipment, magnetic surface crack detectors, fluorescent detectors, and so on. In accordance with their policy of investigating any development which might contribute to a further improvement in efficiency or safety they were greatly interested in the new invention and demonstrations were invited.

Research by railways.

In collaboration with the manufacturers the railways carried out a comprehensive programme of research and development in the application of ultrasonic flaw detection to the avoidance of any flaws in important details of railway equipment. Investigations into the possibilities of this method finished about 1944 by which time it had been conclusively established that the instrument with various modifications and improvements resulting from co-operative research gave a convenient and efficient means of non-destructive testing. The instruments were then handed over to the Chief Mechanical Engineer to use as tools in the investigation of possible flaws in mechanical details and they are also being used for research purposes in the railway workshops at Derby and elsewhere.

Economies resulting.

Before the introduction of ultrasonic detectors it was necessary to dismantle the bogie and remove the wheels from the axles to carry out a thorough examination with existing tools. The use of ultrasonic methods allows every section of the wheels and axles to be rapidly and thoroughly inspected without dismantling the bogies, the saving in time and trouble being thus considerable. Vertical probes have been specially designed for testing such items as axles where great depth is required and their effective surface area is 2 cm. The instruments are so simple to operate that mechanics can quickly be trained to use them, and another important advantage is portability.

Pipe porosity, hair-line cracks, slag inclusions, blow holes, laminations, fatigue cracks, and welding flaws are among the many defects which can be detected by this equipment. The X-ray method requires that the flaw should be several per cent. of the thickness of the sample whereas a supersonic echo can be obtained from cracks of only molecular thickness.

[385. (06 .111]

OFFICIAL INFORMATION

ISSUED BY THE

PERMANENT COMMISSION

OF THE

International Railway Congress Association.

Enlarged Meeting of the Permanent Commission at Stockholm (9th to 12th June, 1952).

FINAL SUMMARIES adopted at the Enlarged Meeting of the Permanent Commission of the International Railway Congress Association (Stockholm, June 1952).

1st SECTION : WAY AND WORKS.

QUESTION I.

A. — What are the new safety measures taken for level crossing of railway tracks by the road in respect of the density, high tonnage and speed of the road traffic?

In particular automatic signalling and closing of level crossings without keepers, worked by the trains themselves.

Technical and statistical investigation in order to ascertain the relative safety of :

1° level crossings with keepers, with the different devices to announce the arrival of the trains to the keepers;

2° level crossings without keepers :

a) without any self-acting device announcing the arrival of trains;

b) with automatic signalling for the road-users;

c) with automatic signalling completed by half- or entire gates.

B. — Cases of level crossing of railway tracks by a road with a railway (urban or suburban) running alongside.

Summaries.

QUESTION I-A.

« 1. — The changes that have occurred « in the character of the road traffic in « modern times, owing to the development of motor traffic and the progressive increase in the number, speed, « and tonnage of such vehicles, mean « that the way level crossings are operated « and equipped must be carefully studied « by the Railway Administrations and « public authorities in order to make the « necessary modifications.

« In endeavouring to improve the « safety at level crossings, financial considerations are of great importance, as « the general interest makes it necessary « to see that the capital available is « spent to the best purpose, as always. « These considerations make it necessary « for the Railway Administrations and « authorities controlling them to grade « as far as possible, the way level crossings are equipped according to the « possible risks, and on the other hand « to make every possible economy without hazarding the necessary degree of « safety at those level crossings where « such economies are possible in order « to finance the cost of equipping more « elaborately other more dangerous level « crossings.

« 2. — In general, substantial improvements have been made in many countries since the Cairo Congress regarding « safety at level crossings, particularly as « regards :

« — the facilities given to road users to « warn them of the existence of all kinds « of level crossings and to enable them « to see when the gates are shut at level « crossings with keepers;

« — the methods of advising the « approach of trains given to the keepers « at level crossings with keepers;

« — improvements to the types of gates.

« The regulations of the Geneva Protocol regarding the indication of the « presence of level crossings have been « supported by a very large number of « countries, which results in an improved « standard of safety both for the usual « road users and for road users making « international journeys.

« 3. — There is now available very « reliable equipment which enables an « automatic signal giving warning of the « approach of a train to be given to road « users coming up to level crossings « without keepers. Such equipment can « be installed and operated relatively « economically, particularly if no positive « line clear light is included, as this « involves using a large amount of « current and the obligatory use of the « power from local supply.

« 4. — Apart from the above considerations of economy, the warning of « the approach of trains is given by an « automatic signal with a degree of « certainty at least equal to or even « superior to that given by gates closed « by a keeper because the latter involves « the possibility of the failure of the « human element, whereas the automatic « signal can be arranged so that the « failure is on the side of safety.

« An exception should be made, how- « ever, of level crossings with keepers « protected by signals with mutual inter- « locking between such signals and the « gates in which case the train is stopped « if the keeper makes any mistake. This « might lead to serious drawbacks finan- « cial and practical as regards the flow « of road traffic and the regularity of « the trains.

« 5. — There remains a great deal to « be done however to discipline road « users, as the danger signal, in the case « of automatic signalling, unlike a gate, « at least when such a signal is merely « a coloured light, is not a material « obstacle preventing the level crossing « being run onto. It is to be feared than « unless such discipline improves, acci- « dents at level crossings without keepers « where there is automatic signalling, « will have more serious consequences, « although in making such a comparison « we must not overlook the risk of « accidents owing to a road vehicle « running into the gates of a level cross- « ing with a keeper and thereby blocking « the line, when had there been no gates « the vehicle might have crossed over « without danger.

« It appears that the addition of light « automatic half-gates may cancel out « the difference in the reactions of road « users, according to whether they find « themselves faced with the closed gates « of a level crossing with a keeper or the « automatic stop signal at a level crossing « without a keeper. In addition, half- « gates seem likely to lessen the special « risks at double track crossings when « the road user is tempted to cross as « soon as one train has passed without « considering another might be coming « in the opposite direction.

« It is extremely desirable that in view « of the special case of such double « crossings, as for all level crossings « moreover where there are no keepers, « when cattle have to cross, the regu- « lations should be clearly laid down and « strictly enforced, wherever this is not « yet done.

« 6. — In view of the probability that « the system without keepers with auto- « matic signalling is likely to be extended, « it is very desirable in order to make it « easier for international traffic to know « and observe the regulations, that unifor- « mity should exist as regards the follow- « ing points :

« — type of signals;

« — whether there is or not a positive « line clear indication;

« — the exact meaning of the danger « signal given (absolute stop or permissive « stop);

« — in the case of level crossings without « keepers, the adoption of a road signal « at a distance from the crossing showing « whether the crossing in question is or « not equipped with automatic signal- « ling;

« — systematic use at the crossing itself « of the St. Andrews Cross sign with a « double cross in the case of double « track line (or some other signal designed « with the same object);

« — definition of what the road user « should do when anything is out of « order.

« 7. — Doing away with keepers is a « definite source of economy. In addition,

« it is also of general interest in that « labour is freed for use on more pro- « ductive sections.

« There are a fair number of cases in « which the characteristics of the level « crossing : amount and kind of road « traffic, amount of railway traffic, visi- « bility, enable such a crossing to be « operated as a crossing without keeper « without signals with sufficient safety. « Regulations concerning keeping the « view open near level crossings are « likely to facilitate the extension of this « practice and also improve the safety.

« The question of deciding whether it « is possible to substitute on a large scale « the system without keeper with auto- « matic warning of the approach of trains « to that of having a keeper should be « gone into very carefully. At the « present time, it does not appear possible « to decide the upper limits at which « such a substitution is applicable, as « such limits vary according to the « education and discipline of the road « users : in countries where automatic « warning of the approach of trains is « not widely used, it appears advisable « to fix such limits very prudently, as « they can always be extended later on. « Moreover, it appears that the addition « of automatic half-gates makes it possible « to extend these limits, especially in the « case of double track crossings. Such « half-gates should be very light so that « there will not be any serious conse- « quences if they are run into. The « addition of automatic gates right across « the road is still more satisfactory as « regards the behaviour of the road users, « but this raises very serious problems « should anything go wrong with the « installation, so that their general use « appears impracticable; automatic gates « also raise the problem of what kind of « distant road signal should be used.

« 8. — In the case of level crossings « without keepers without signals, the « installation of automatic signals giving « warning of the approach of trains « appears a solution to be recommended « when an increase in the amount, speed « and tonnage of the road traffic jeopar- « dises the safety of the existing system « and the problem cannot be solved in « any other way, such as by reducing « the speed of the road and railway « traffic, increasing the visibility, under- « taking various work such as cutting « back banks and introducing regulations « about keeping the view clear at level « crossings.

« 9. — If the installation of automatic « signalling device indicating the ap- « proach of trains is required to improve « the security on account of the change « of the character of road traffic it is « only fair that the major part of the « expenses of such installation should be « borne by the road authorities.

« Similarly, if such installation is to « expedite the road traffic it is likewise « only fair that the road authorities « should contribute to the expense of this « installation.

« 10. — There are cases especially on « British Railways where because of the « change which has taken place in the « population and density and character « of road traffic, private level crossings « raise very complicated questions.

« In most of the other Administrations « it would seem on the contrary that

« level crossings of this category do « not raise any great difficulties.

« It appears desirable, however, not to « increase the number of these crossings. « Where new private level crossings are « made it seems essential to insist that « they should have at least the same « degree of visibility as level crossings « without keepers and without automatic « signalling, and to take appropriate « security measures in specially agreed « cases at the expense of the road user.

« In the case of heavy road vehicles « it is recommended that the users of the « level crossings should give prior advice « to the Railway Administration before « using the crossing.

« It is also recommended to insist on « rigid adherence to all obligations on « the part of the users with regard to « padlocking of gates.

« 11. — In general it is recommended « that special consideration should be « given to the methods adopted for the « education of the public to ensure that « drivers of all vehicles should approach « and cross level crossings with care.

« 12. — The methods now used by « the different Administrations to prepare « statistics of accidents at level crossings « make it very hard to come to any « conclusions about them. Thus, whilst « recognising the complexity of the « question, the Commission expresses a « wish that the uniform preparation of « as detailed as possible statistical tables « should be studied. »

***

QUESTION I-B.

« The problem of a level crossing at « which a light railway or a tramway « runs alongside the road seems to have « been dealt with on more or less the « same lines in the different countries. « In principle, the level crossings in « question have keepers.

« If the light railway or tramway does « not run on sight, the crossing is exactly « the same as that of the crossing of two « railway lines, priority being given in « principle to the main line trains.

« If the light railway or tramway line « runs on sight at the level crossing, this « is usually treated just like an ordinary « level crossing, which is protected if « necessary by signals on the line. In « certain cases, derailing points have « been fitted on the light railway or « tramway line to protect the crossing « when closed.

« The enquiry only revealed very rare « instances of level crossings without « keepers with automatic signalling at « which a light railway or tramway line « ran alongside the road. No particular « measures appear to have been taken « in connection with such level cross- « ings. »

3rd SECTION : WORKING.

QUESTION II.

What are the quickest and most economical means to carry out door to door service for railway transports?

What are the best conditions of use of containers for small miscellaneous traffic (dimensions of the containers, conditions of ownership, tariffs)?

What are the packing types to be recommended?

Summaries.

« 1. — The ever growing cost of hand-« ling operations and the speeding up of « competitive road methods oblige the « railway increasingly to have recourse « to improved technical methods in « order to realise door to door transport « with the maximum speed at the mini-« mum cost and damage.

« 2. — The private siding still remains « the most economical way of assuring « the door to door technique, on condi-« tion that the capital costs are spread « over a large number of wagons, that « operating costs are reasonable, and that « the siding is so laid out that the wagons « can be brought right up to the required « sites.

« 3. — In order to reduce the costs for « the use of private sidings linked up « with stations by lines common to « several firms (feeder sidings), the rail-« ways should endeavour to ensure that « the cost for the use of the feeder « siding should be reasonable and con-« sider to what extent it is profitable to « share in financing the feeder sidings.

« 4. — Certain railways attach great « importance to letting their clients have « depots in their stations or goods depots « under favourable conditions.

« 5. — Where it is not possible to « build new private sidings or there is no « justification for them, the container, « the wagon-conveying trailer and the « rail-road trailer are auxiliary methods « which enable full loads to be taken to « the client's premises, thereby assuring « a close link between the railway and « its clients.

« 6. — From the point of view of speed, « provided the carting distance is short, « there is not much to choose between « the three methods.

« From the point of view of cost, the « container (*) is the cheapest method « for certain types of traffic but the « road-rail trailer and the container « « pa » which are more expensive in

(*) In this context the term « container » refers to a large container which can only be transferred between rail and road vehicles by means of a crane or similar appliances.

« capital outlay than the ordinary con-
« tainer, can, if the traffic is sufficient,
« be cheaper to run.

« The wagon carrying trailer, which
« is very expensive in capital outlay, can
« if the traffic is sufficiently important
« and the terminal distance short, be
« justified from an economic point of
« view in cases where it is impossible to
« build private sidings.

« The information available concerning
« comparative working costs is incom-
« plete and inconclusive. A closer inquiry
« into costs is needed and a study aimed
« at reliable comparisons of all-in work-
« ing costs of the various methods used to
« provide door to door service for the
« same kind of traffic in comparable
« circumstances. Many Administrations
« now have staff employed upon costing
« research and in the light of the reports
« presented, it is recommended that the
« Congress should promote a special
« inquiry into the costs, conducted by
« experts in modern costing technique,
« who would agree beforehand the precise
« information to be obtained, the ele-
« ments of cost to be included and the
« costing technique to be used.

« 7. — Certain railways consider that
« the best way of assuring door to door
« services by means of containers is to
« make the greatest possible use of the
« usual cartage vehicles and standard
« wagons.

« Specialization of the equipment for
« transport by containers may involve
« the multiplication of types of equip-
« ment and the risk of less intensive and
« therefore more costly user.

« 8. — Where containers of the
« ordinary or « pa » type or road-rail
« trailers are the means employed for
« door to door transport, it seems that
« the development of their use would be
« assisted by the creation of centre
« stations, well equipped in all respects,
« served by direct trains and by com-
« plementary road transport facilities
« for feeding and distributing within the
« area covered by each centre station.

« Development of the door to door
« transport should also aim at the
« maximum standardization of the equip-
« ment and thus facilitate combined
« traffics.

« 9. — Small containers of 1 to 3 cubic
« metres (35 to 106 cub. ft.) on wheels,
« large numbers of which are used on the
« continent of Europe, are operated in
« two different ways : in the one case,
« they belong to the transporter (railway
« or affiliated company), and in the
« other, to private firms. As a general
« rule, they are loaded by the user.

« The clientele seems to prefer con-
« tainers of 1 to 2 cubic metres (35 to
« 70 cub. ft.).

« Privately owned containers (those
« belonging to consigning firms excepted)
« find it difficult to obtain a load for the
« return journey, chiefly on account of
« their specialization, so that the empty
« mileage tends to equal the loaded
« mileage, which is costly for the railway,
« even if empty containers are charged,
« owing to their low specific weight.

« The railway has every interest in
« reducing empty runs, either by a policy
« of acquiring its own containers (under
« its own management or farmed out),
« or by effective tariff measures.

« 10. — Pallets and box-pallets used « in conjunction with fork-lift trucks or « other similar lifting appliances can « prove of real advantage in handling « parcels, which are transported grouped « into consignments of a certain size.

« The full advantage is taken of pallets « only when they are conjointly used by « the producer, the stockist, the trans- « porter and the consignee. Their « advantage increases according to the « number of handlings involved.

« The parcels grouped into lots cor- « responding to the capacity of the pallets « and the power of the fork-lift trucks « should remain if possible loaded on « the same pallets throughout the jour- « ney.

« The most economical method of « operation appears to involve the use « of standardized pallets from a pool, « this pool being owned in common by « the transporters and the business firms « involved, but there are many difficulties « to overcome.

« In any case, it is necessary to assure « that the ownership of the pallets and « the tariffs for empty and loaded runs « should be so established that the « railway receives a fair payment for the « additional loads it carries.

« 11. — Packings justify their cost by « the services rendered to the consignor « and the transporter. The packing « contains or holds the goods together « and protects them; it often modifies « their form. The consignor can use it « for publicity purposes, without the « cost being appreciably modified thereby.

« 12. — Effective packing makes it « possible to reduce handling and depot « costs, as well as the transport insurance « premium paid by the consignor.

« 13. — The method of packing « influences the cost of the transport and « in particular the cost of handling, « capital costs and maintenance costs for « the rolling stock, as well as the sums « paid out for damage.

« 14. — In order to meet requirements, « packing must be : inexpensive, light, « resistant, attractively presented. The « dimensions and designs must allow « for :

« — strength, easy stocking and handling « of the packages;

« — suitability of loads;

« — best use of transport equipment and « handling appliances.

« To achieve these objectives it is « necessary to recommend the use of « standardized packings which comply « with certain criteria studied by the « carriers in collaboration with the manu- « facturers of packing and the consi- « gnors.

« 15. — As opposed to heavy packing « which can be used for several journeys, « the present trend in commercial practice « is to do away with the heavy costs « involved in the transport of returned « empties.

« Moreover, it is in the carrier's in- « terest to avoid excessive re-use of « packings, which results in a rapid « weakening of their resistance, leading « to damage.

« In view of the fact that the use of « new (non-returnable) packing gives the

« greatest guarantee so far as solidity « and hygiene are concerned, and pre- « serves the good appearance of the « goods, it therefore seems advisable to « recommend its application in all cases « where this method can be technically « and economically introduced.

« 16. — The resistance and conse- « quently the cost depend on the number « of handling operations involved.

« As these tend to be more numerous « in rail transport (apart from door to « door service) compared with road « transport, the railways find themselves « in a weaker position than their com- « petitors. In these circumstances the « railways should :

« — endeavour to carry out a persuasion « campaign for good packing and, at the « same time, give the consignor the « benefit of their experience and their « laboratory tests;

« — apply if needs be the appropriate « charges (such as adjusted charges « including acceptance by the railways « of greater liability in case of damage), « which will only be applied to goods « carried in approved new (non-return- « able) types of packing, thus giving the « consignor a share of the benefit derived « from the use of adequate packing. »

SECTION IV. — GENERAL.

QUESTION III.

Economic aspects of :

a) discontinuing service on old railway lines,

b) construction of new railway lines,

with regard to the possibility of handling transport with other means.

Summaries.

« 1. — The economic aspect of :

« *a)* the closing of existing railways,

« *b)* the construction of new railways, « constitute a special aspect of the general « economic, social and, at times, the « political problem of the organisation « and co-ordination of transport.

« The problem has its origin in the « fundamental changes in the means of « transport since the coming of railways « as well as in the changes which have « taken place in commercial and indus- « trial requirements.

« It is therefore necessary to re-examine « the transport problem in relation to « all the existing forms of transport. « This examination must be carried out « in such a way as to determine the « means of transport to be abandoned « and the new forms to replace them.

« 2. — In order to enable the railways « to fulfil, under the most economic « conditions, their role as general trans- « port undertakings, they must be em- « powered, within the general framework « of transport legislation, under certain « circumstances with a priority right to « provide and to operate the most econ- « omic form of transport.

« This solution will assure transport « users the best guarantee of safety, « comfort and adequacy of service.

« 3. — In such a system of public « transportation, road transport is, in « principle, used as a means of regional « collection and dispersal from and to « certain concentration points situated on « the most important railway lines. Under « these circumstances, road transport may « be substituted, within the bounds need- « ed, and under the responsibility of the « railways, for rail service.

« Experience shows that such substitu- « tion is most easily arranged and admi- « nistered under a single authority (*). « Complementary rail/road service has « never been attainable where there is « far-reaching competition between se- « parate rail and road undertakings.

« 4. — For economic reasons, railway « administrations must be authorized to « close down a railway line or to substi- « tute a road service for a railway service.

« If this authorization is not granted, « the railway administrations must re- « ceive compensation for the amount of « potential saving, they are not permitted « to realize.

« 5. — It is generally admitted that

(*) From an exchange of views during the plenary meeting, it is understood that it is only the railway administrations, who must organize and manage the substitute road services. By « authority », it is therefore meant the railway administration.

« the partial or total suppression of the « railway service should be achieved on « lines with very light traffic.

« Studies which have been made in « this sphere by certain railway admi- « nistrations have indicated that where « traffic is less than 250 000 traffic units « per annum and kilometre of line, « then it is more economical to ensure « traffic by road rather than by rail on « the basis of retaining railway rates.

« 6. — The experience of certain « European railway administrations in- « dicates that the withdrawal of passenger « services on lines with a mixed traffic « and their replacement by road services « will lead to an appreciable increase « in the daily mileage operated in com- « parison with the passenger train service.

« While improving the service, it makes « possible the achievement of the major « part of the economies which could be « obtained by complete closure.

« 7. — The withdrawal of freight trains « and the closing down of the line « cannot generally be considered unless « the public have the opportunity of « loading and unloading their freight « traffic at another station — without « excessively extending the length of « haul — or unless the railways can carry « out the road transport without the « additional expenses exceeding the econo- « mies realised.

« In the latter case, it becomes advisable « to use either, on the one hand, containers « or similar carrying equipment, or on the « other hand, wagon-carrying trailers.

« It should be pointed out that on « lines of mixed traffic the suspension of « freight services generally only brings « about comparatively limited savings.

« 8. — The building of new lines is « practically no longer justified except in « incompletely developed or exploited « regions. It usually arises out of the « need for freight transport facilities.

« There may, however, be justification « for the new construction of urban and « suburban passenger lines in order to « relieve the overcrowding of rail and « road services or to provide for the « growth of a city and the spread of the « population.

« 9. — According to estimates made « by various railway administrations, the « minimum traffic density justifying the « building of a new separate line should « be between 300 000 and 500 000 traffic « units per annum and per kilometre of line.

« When it is a question of a new feeder « line to an existing line or network, the « return on the capital of the new line « can be ensured by a lesser level of « traffic than that referred to in the « preceding paragraph.

« Smaller volumes of traffic can be « handled more economically by road, « provided that roads are capable of « carrying heavy vehicles with trailers.

« 10. — In order to ensure more easily « the return on capital on a new line, « railway administrations might be « authorized to depart, in certain cases, « from the general obligation of applying « uniform rates throughout the system; « and therefore to put into force higher « rates on these lines than those generally « applicable.

« The application of a similar policy to « lines with a light traffic might be « desirable in those cases where it would « make possible the continued operation « of these lines. »

[385. (09 .2]

OBITUARY.

Germain WILLAERT,

Consultant to the General Management of the Belgian National Railways.
Member of the Permanent Commission of the International Railway Congress Association.

M. Germain Willaert, Consultant to the General Management of the Belgian National Railways and a member of the Permanent Commission of our Association, died in Brussels on the 4th October 1950.

This sad news was given to the International Railway Congress Association at the time the XVth Session was meeting in Rome, and caused great consternation to those taking part, most of whom had known the deceased either as a delegate and assiduous and devoted member of the Permanent Commission or as a colleague on the Belgian National Railways.

M. Willaert was born in Bruges, on the 6th May 1884.

He spent his childhood in this city, where the peaceful canals, and mediæval towers and houses evoke a glorious past, profound poetical sentiments, and artistic appreciation, as evinced in his pure and polished language.

After having completed his Civil Engineering studies at the University of Ghent in 1907, M. Willaert was appointed that same year to the position of Engineer in the Way and Works Department at Arlon.

In 1909, he was transferred, at his own request, to the Permanent Way Department at Bruges, and the next year became assistant to the Manager of the Special Constructional Department of the Brussels Stations.

In 1913, he obtained the diploma of Electric Engineering from the University of Ghent.

In 1921, M. Willaert,at his own request, was transferred to the Signals Department where he was put in charge of the reconstruction of the signalling, which had greatly suffered during the war, and perfected the three position signalling system

recently adopted on the Belgian Railways, as well as electric colour light signalling.

Since January 1924, M. Willaert was in charge of the Railway Operating Course at Ghent University, which position he continued to hold until the end of his life.

In the Signalling Department, M. Willaert obtained in 1926 his nomination as Chief Engineer, and in July 1932, he was promoted to the grade of Head Engineer.

From that time, he took charge of this important Department and was responsible for the happy conclusion of many important signalling works due to the re-arrangement of the Brussels-Nord and Brussels-Midi Stations, works for which he was complimented by the General Manager, M. Foulon.

In recognition of the eminent services rendered during the course of his career, M. Willaert was promoted in 1945 to the rank of Consultant to the General Manager and was given the Management of the Technical Secretariat of the General Management and the Accident Department.

M. Willaert was appointed a member of the Permanent Commission of the International Railway Congress Association at the meeting of the 2nd February 1946. His participation in the works of the Congress dates back to the Madrid Session (1930), where he was a reporter on Question XI : Signalling on lines with fast trains and at large stations — Light Signals — « The automatic block ». He took part in the Enlarged Meeting at Brussels in 1939, as well as at the Lucerne Congress in 1947 and the Lisbon Meeting in 1949. He always showed the greatest interest in the works of our Association.

All his colleagues, friends and collaborators will retain a very happy memory of his wonderful sense of synthesis, of the clarity of his judgement and the uprightness and loyalty of his character.

His death leaves many regrets amongst those, who had the good fortune to profit by his excellent advice on the Permanent Commission of our Association.

The Executive Committee.

[536 06 (44)]

IVth International Congress of industrial heating.

(Applied thermics and thermodynamics.)

(Paris, 27th September to 4th October 1952.)

The fourth International Congress of the Industrial Heating (Applied thermics and thermodynamics) will take place in Paris at the National Conservatory of Arts and Crafts from the 27th September to 4th October 1952.

Its object is the scientific, economic and legislative study of all questions relating to the production and utilisation of calorific power under all its forms.

Subscriptions to the Congress are now due and should be sent to the *General Secretariat,* 2, rue des Tanneries, Paris (XIII^{e}), which will also supply those interested with all the information they require should they wish to take part in this Session.

While this Congress is being held, an Exhibition of Industrial Heating will take place from the 27th September to 12th October 1952, at the Parc des Expositions in Paris, Porte de Versailles. All information about this exhibition can be obtained from the *General Commissariat of the Exhibition,* 66, rue de Rome, Paris (VIII^{e}).

NEW BOOKS AND PUBLICATIONS.

[**621** .132 .1 (09 (42)]

AHRONS (E. L.). — **Locomotive and train working in the latter part of the nineteenth century.** — *Volume I.* — One volume (6 5/16 × 11 1/4 inches) of 152 pages with illustrations. — 1951, Cambridge, W. Heffer & Sons Ltd., 3 & 4 Petty Cury. (Price : 15 s. net).

This book, which is the first volume of a series of five, is a collection of the articles by E. L. AHRONS (1866-1926), published in the *Railway Magazine* between 1915 and 1926.

Each chapter is devoted to one or other of the former Railway Companies of Great Britain, listed below (together with the date of publication of the original article) :

Great Northern Railway	1915
Manchester, Sheffield and Lincolnshire Railway	1915
North Eastern Railway	1916-17
Great Eastern Railway	1918
Midland and Great Northern Joint Railway	1923
Hull and Barnsley Railway	1924

The book deals with the operating conditions on each of these Railways during the last five years of the nineteenth century.

The author enumerates the different types and the number of steam locomotives used on the main lines for transporting passengers and goods. He gives a general idea of the timetables and performances realised, and mentions, in a critical fashion, the evolutions and transformations undergone by the locomotives at the end of the last century.

This book forms a very interesting document from the historical point of view and contains a large number of photographic documents showing the locomotives mentioned in the text.

U.

[**385** (09 (3)]

World Railways 1950-1951. — A survey of the operation and equipment of representative Rail Systems. — *First Edition.* — Collected and edited by Henry SAMPSON. — One volume (8 3/4 × 13 inches) of 600 pages, copiously illustrated, numerous maps. — 1951, London, Sampson Low, Marston & Co. Ltd., 25 Gilbert Street, W. 1.

The object of the editor was to present in an easily consulted manual details on the operating methods and equipment of various railways throughout the world.

The information supplied by the Administrations and manufacturers would have made it possible to compile a very extensive report on these two subjects. But the need to keep the book within reasonable limits explains why only the most important railways are the subject of detailed descriptions. However the fundamental details on many small railways are sufficient to give an idea of their main characteristics.

The basic details given are : the gauge of the permanent way, the length of lines and the composition of the rolling stock. However, as far as possible, particularly in the case of the biggest railways, there is in

addition : a map of the system, a brief history of the railway, the way the movement of the trains is controlled, the kind and extent of the traffic, details about the permanent way and profile of the lines, rolling stock gauge and clearance. In the case of the rolling stock, photographs, dimensioned diagrams and tables of the leading dimensions show the most interesting facts in the case of the most representative types of locomotives, passenger coaches and goods wagons.

For some countries, particularly Eastern Europe and Asia, official up-to-date information was lacking, but particulars were however collected from satisfactory and authentic sources.

The rolling stock is the main subject of the illustrations. This is due not only to the fact that it lends itself thereto, but also because it is the most obvious and characteristic part of the undertaking. Locomotives naturally take pride of place, and it would be difficult to find another equally abundant collection of traction engines. All types are shown, as well as all the ways of using natural sources of power.

In perusing these pages with their outlines of all the up-to-date locomotives, it is easy to appreciate the broad lines which the evolution of traction has followed in recent years. After having held its own against competition by successive improvements, the steam locomotive has encountered a new and formidable adversary in the United States. Diesel-electric traction has rapidly come to the force in the orders of nearly all the large railways. It has even beaten another ancient competitor, electric traction. On other continents, « dieselization » in spite of less favourable circumstances, is also very much to the fore, at least in the case of special services. Another newcomer, the gas turbine, has already shown its possibilities in the case of several prototypes. That of the Swiss Federal Railways was put into regular service in 1945 for passenger services on the Bale-Strasbourg line.

Although there has been this real revolution in the design of locomotives, they have not been the only ones to profit by the new discoveries of science and industry. The many types of passenger coaches and goods wagons described in this book show that the rolling stock has become more rational, more economic and better adapted to the requirements of the public. Some of the drawings show complete streamlined trains, the impression of speed given being confirmed by their actual performances.

Modern signalling methods, remarkable bridges, and audacious layouts add variety to the extremely abundant illustrations.

Owing to the methodical arrangement and condensed form which are amongst the attributes of this book, the enormous amount of information it contains is a mine in which the reader can browse with ease. He will find therein all the essential details concerning the activities of most of the railways of the world.

E. M.

[31 (3)]

Statistical Yearbook 1949-1950. — Second year. — Published by the Statistics Office of the United Nations, Economic Department. — One volume (9 × 11 1/2 inches) of 556 pages, with numerous tables. — 1950, New York, publishers : the above mentioned Organization.

This is a very copious document which the United Nations Organization has published. The tremendous resources available to such an organization were needed to collect together the data required for a document on such a scale.

The statistics cover the entire world and nearly every activity. The numerical

tables, most of which are very detailed, give details for the various countries on : the population and its demography, the exploitation of the richness of the soil and subsoil, manufacturing industries, the production of gas and electricity, transport and communications, commercial relations, finances, social statistics, and cultural details.

On the subject in which we are most interested, railway transport, comparative statistics covering several years deal with the composition of the rolling stock, world goods traffic and then the goods and passenger traffic country by country.

Road transport is estimated by the number of motorcars in service.

Maritime transport is shown by the number of boats in service, the tonnage loaded and unloaded, the boats leaving and coming into port. In the case of inland waterways, the figures cover the goods transported.

The chapter on transport ends with a table of the regular civil air services from 1930 to 1949, and another relating to international tourist traffic in 1948.

It would be superfluous to insist on the value of this publication. There is no aspect of the economic life of any nation that has not been analysed and broken down into figures. The economist, the financier, the business man will find it invaluable. Railway officials will also find much matter for instructive comparisons.

E. M.

[**385 .5 & 656**]

The Co-ordination of Transport : Work Problems. Second question on the agenda of the 4th Session (Genoa, 1951) of the Internal Transport Commission of the International Organization of Work. — One volume (6 5/16 × 9 7 /16 inches) of 198 pages. — 1951, Geneva. Published by the « International Work Office ».

It should not be concluded from the title of this report that the authors intended to imply that Work Problems are the keystone of the question of co-ordination. They noted, on the contrary, that although the living conditions of the workers are one of the characteristic and not the least important factors of various undertakings, the organization of transport gives rise to other very difficult problems. By reporting the reactions of the affair, the authors have also shown that the United Nations have considered the question of co-ordination as a whole. An examination of the regional activities of the economic Commissions of the O. N. U. gives us an idea of the extent of the investigations now in hand.

As far as Europe is concerned, the Internal Transport Committee of the European Economic Commission has set up various special working groups to study different points relating to co-ordination. As a result of several suggestions inspired by a desire to respect the principle of a rational distribution of the works, the International Work Office was made responsible for drawing up a report on the question : « Work problems affecting the co-ordination of transport. » It is hardly necessary to point out that the wages of the workers affect the cost of transport, a question one of the working groups had to study.

The B. I. T. sent a questionnaire (given in the appendix) to the Governments of a certain number of selected countries in four continents. The replies received served as a basis for the present report.

In the first chapter, the authors examine the general aspects of co-ordination and endeavour to determine how the absence of co-ordination can affect the employees.

In the second chapter, they study the

conditions of paid work: salaries, indemnities and other benefits. Abundant and interesting though it is, the information collected has certain gaps which have limited the study to a comparison between rail and road. It was also necessary to leave on one side the question of transport on behalf of the staff. But the report is nevertheless very instructive. It made it possible to formulate certain definite conclusions, amongst which mention may be made of the following: conditions of employment and work are better in the case of railway transport, together with higher wages on the whole, especially in the case of certain categories of staff.

In the chapter dealing with social security, the report gives details of the systems in force in various countries, and certain systems applying to railway workers in Belgium, Canada, the United States, France and Switzerland. Finally, very detailed information is given about the cost of social security for undertakings in nine countries.

Regarding the regulations on working hours, rest periods and holidays, the examination of the information supplied was intended to make a comparison between different kinds of undertakings. It showed that in the case of the railways the regulations are more uniform and cover nearly all the staff, whereas in the case of road transport and inland waterways the regulations vary considerably and many operators are not covered by any regulations at all.

In chapter V: Conclusions, the report confirms that working conditions and wages are better on the railway than in the case of road transport. The limited information available tends to show that the situation is also less favourable in the case of inland waterways. In addition, the authors examined a series of questions on the methods that should be used to lessen the effects of differences in working conditions on competition, and prevent such competition lowering the standard of living of the workers.

E. M.

[**656** .281 (54)]

LATHAM (W.G.), B.A., F.P.W. Inst., Deputy Chief Engineer of the Madras and Southern Mahratta Railway, and ISAACS (E.W.), A.M. Inst. Mech. E., A.M. Inst. Loco. E., Deputy Chief Mechanical Engineer of the East Indian Railway. — **Report on derailments.** — Report published by the Indian Railways Administration. — One brochure (8 1/4 × 13 in.) of 64 pages, tables and diagrams. — 1951, Madras. The Madras and Mahratta Railway Press.

This report is the work of a team of two engineers who were charged in October 1950 with the special mission of making an enquiry into derailments in India and suggesting suitable ways of reducing their number.

The general statistics supplied by the Offices of the Administration show that accidents due to derailments were more numerous than during the immediate prewar period, especially on certain railways.

The method adopted was first of all to ask the various railways for details of derailments occurring during the 18 months ending on the 30th September 1950. Armed with what they learnt from these details, the reporters proceeded to make examinations on site. On the other hand, the figures collected were classified in various ways by means of perforated card indexing machines: in three periods of six months under seven general headings, according to the month of the year, the gauge of the track, the hour of the day, in large marshalling yards, according to the cause.

The results of these investigations are to be found, together with the necessary commentary, in the chapters dealing in turn with: the permanent way, locomotive failures, failures of coaches and wagons,

the work of the operating staff, mistakes of locomotive crews, and various other causes.

A special chapter is devoted to a discussion on the construction of marshalling yards with gravity humps. This is followed by another recalling certain regulations relating to the working of such marshalling yards and the possibility of their application as a whole.

In their report, the authors explain and justify detailed measures of a practical nature to prevent the causes of derailments. These numerous suggestions are collected together in the final chapter : summary of the recommendations made.

Through the Central Administration this report was distributed to all employees likely to profit thereby and the recommendations with which it closes were the subject of a service note.

In general, the measures suggested are inspired by the special conditions of the Indian Railways. However, a certain number of them are of general interest. Thus, from considerations of static equilibrium, the authors show the danger there may be in too great a difference in the camber of the suspension springs when not under stress, especially when not loaded or irregularly loaded, and from this base an argument in favour of closer tolerances.

The considerations on the profil of the marshalling yard humps, space braking and braking to a stop, on the work of the brakesmen and pointsmen and the grouping of the switch control points will also be read with interest.

E. M.

[**385** (08 (59)]

SANDERS (J.O.), C.M.G., M. Inst. T., A.M. Inst. C.E., General Manager of the Malayan Railway. — **Malayan Railway Administration Report for the year 1950**. — One volume (7 7/8 × 13 inches) of 92 pages, diagr. and map. — 1951, Kuala Lumpur : Charles Grenier & Son Ltd., Printers.

This report follows the same plan as the previous ones. However, on account of the overload on the services, certain explanations and commentaries had to be omitted. In spite of this, the report is very readable. This is due to the judicious selection of the statistical data included. These are all of real significance, whether they give a picture of the position of the railway or its operation.

The information given is divided into 18 chapters. These relate to the financial position, the evolution of the traffic, the mileage of the trains and engines, to accidents, mechanical and electrical installations, the permanent way and signals and telecommunications, and reconstruction work. In the appendices, which number twenty-five, there is a more detailed analysis of various subjects : the receipts and expenditure on the capital account, the operating receipts and expenditure and various funds, and the situation as regards the rolling stock.

It is to be regretted that the year 1950 was again marked by the acts of the terrorists. In addition to the cost involved in making repairs and taking safety precautions, these resulted in a serious reduction in the capacity of the railway. In spite of this, thanks to the efforts of the departments concerned, there was an increase of 16 % in the goods traffic and 25 % in the net ton-miles. Owing to the troubled political situation, the railway was not however able to meet all transport demands. Certain traffic had to go by road, and it is to be feared that it will therefore be lost to the road in the future.

On two introductory pages, circular diagrams represent the sources of the receipts with their relative importance, and the distribution of the costs in the same way. In the case of the costs, it will be seen that as on most railways, the heading « staff » accounts for the greater part, though not so much as in some cases : 57.62 %. This item is increasing although the number of employees has been falling for some years.

On the whole, the financial situation appears to be satisfactory. The receipts are 11 % higher than the corresponding figures for 1949, the highest to date. The costs have increased by 9 %. The surplus has been diverted to the renewal fund.

In general, it will be noted that reconstruction is going hand in hand with the modernization and improvement of both the fixed installations and rolling stock. We will only mention one point amongst those showing the progressive attitude of this railway — the mechanization of the accountancy services. The use of perforated card indexing machines and other electric calculating machines has made it possible to obtain economies whilst being able to prepare interesting statistics.

E. M.

M. WEISSENBRUCH & Co. Ltd.
Printer to the King

(Manag. Dir.: P. de Weissenbruch,
238, chaussée de Vleurgat, XL)

PRINTED IN BELGIUM

Edit. responsible : P. Ghilain